SCHEME OF EXAMINATION

&

SYLLABI

for

Bachelor of Technology Programmes of Studies under the aegis of University School of Information, Communication &Technology offered at Affiliated Institutions of the University

(1st Year Common Scheme and Syllabus, 2nd year Scheme and Syllabus and Scheme of Studies for higher semesters)

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

University School of Information, Communication &Technology
Sector 16C, Dwarka, Delhi – 110 078 [INDIA]
www.ipu.ac.in

Applicable from Batch Admitted in Academic Session 2021-22 Onwards

CONTENTS

Approval History:

1. 1st year scheme and syllabus (1st and 2nd semester) and Framework for higher semesters (3rd to 8th) implemented from 2021-22 batch approved by 55thBoard of Studies of USICT held on dated 31.10.2021 .

2. 1st year scheme and syllabus (1st and 2nd semester) and Framework for higher semesters (3rd to 8th) implemented from 2021-22 batch approved by Academic Council Sub-committee on dated 22.11.2021.

3. Modification to BS-103 / BS-104 syllabus implemented from 2021-22 batch approved by 56thBoard of Studies of USICT held on 24.01.2022 .

4. 1st year scheme and syllabus (1st and 2nd semester) and Framework for higher semesters (3rd to 8th) implemented from 2021-22 batch approved by 52ndAcademic Council vide agenda item 52.14 on dated 22.02.2022.

5. Modification to BS-103 / BS-104 syllabus implemented from 2021-22 batch approved by 52ndAcademic Council held on dated 22.02.2022 vide agenda item no. AC 52.33.

6. Scheme of study of 2nd and higher years approved by the 58thBoS of USICT held on dated 10.09.2022.

7. Scheme and Syllabus of 2nd year approved by the 58thBoS of USICT held on dated 10.09.2022.

8. Inclusion of lateral entry guidelines and bridge course with effect from lateral entry admissions in the year 2022-23 (regular batch 2021-22) approved by BoS on 10/09/2022. And, the same approved in AC subcommittee on dt. 14.09.2022.

9. Inclusion of Basic Chemistry in lieu of Applied Chemistry for admitted students in the 1st year, for students who did not study chemistry at 10+2 level, approved by BoS on 10 /09/2022 w.e.f academic session 2022-23. And, the same approved in AC subcommittee on dt. 14.09.2022.

10. Scheme of study of 2nd and higher years approved by Academic Council Sub-committee on dated 14.09.2022

11. Scheme and Syllabus of 2nd year to be approved by Academic Council Sub-committee on dated 14.09.2022.

Provision for Smooth Implementation

This document describes the curriculum of the Bachelor of Technology Programmes that are (or allowed to be) offered at the affiliated institutions of Guru Gobind Indraprastha University, Delhi, under the aegis of the University School of Information, Communication and Technology. In the event of any difficulty of implementation, and / or interpretation of any clause of the document, the same may be brought to the notice of Dean of the University School of Information Communication and Technology. The decision of the Dean, University School of Information Communication and Technology shall be final and implemented to resolve the issue. The same shall be put up in the subsequent meeting of the Board of Studies of the University School of Information Communication and Technology for its approval. If the decision of the Board of Studies of the University School of Information Communication and Technology is at variance with the decision taken earlier by the Dean of the School, the decision of the Board shall be effective from the date of the approval by the Board of Studies. In the interim period (between the approval of the Dean, of the School and the Board of Studies approval), the decision already taken by the Dean of the school shall stand.

Programme Outcomes

1. **Engineering Knowledge** (**PO01**): Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis** (**PO02**): Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions** (**PO03**): Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems** (**PO04**): Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:
    a. that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques;
    b. that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;
    c. that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;
    d. which need to be defined (modelled) within appropriate mathematical framework; and
    e. that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.
5. **Modern Tool Usage** (**PO05**): Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society** (**PO06**): Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability** (**PO07**): Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics** (**PO08**): Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work** (**PO09**): Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication** (**PO10**): Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance** (**PO11**): Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning** (**PO12**): Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Acronyms for Core Disciplines:

CSE	:	Computer Science and Engineering
IT	:	Information Technology
CST	:	Computer Science and Technology
ITE	:	Information Technology and Engineering
ECE	:	Electronics and Communications Engineering
EE	:	Electrical Engineering
EEE	:	Electrical and Electronics Engineering
ICE	:	Instrumentation and Control Engineering
ME	:	Mechanical Engineering
CE	:	Civil Engineering

Acronyms for Emerging Area Disciplines:

MAE	:	Mechanical and Automation Engineering
CSE-AI	:	Computer Science and Engineering (Artificial Intelligence)
CSE-AIML	:	Computer Science and Engineering (Artificial Intelligence and Machine Learning)
CSE-DS	:	Computer Science and Engineering (Data Science)
CSE-IoT	:	Computer Science and Engineering (Internet of Things)
CSE-ICB	:	Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology)
CSE-Net	:	Computer Science and Engineering (Networks)
CSE-CS	:	Computer Science and Engineering (Cyber Security)

Acronyms for Minor Specializations*(Applicable only for Core Disciplines)*:

AI	:	Artificial Intelligence
AIML	:	Artificial Intelligence and Machine Learning
DS	:	Data Science
BT	:	Block Chain Technology
IoT	:	Internet of Things
ICB	:	Internet of Things and Cyber Security including Block Chain Technology
Net	:	Networks
CS	:	Cyber Security
MLDA	:	Machine Learning and Data Analytics
SC	:	Soft Computing
SE	:	Software Engineering
FSD	:	Full Stack Development
IPCV	:	Image Processing and Computer Vision
RA	:	Robotics and Automation
ES	:	Embedded Systems
VLSI	:	VLSI Design
WMC	:	Wireless and Mobile Communications
EV	:	Electrical Vehicles
MT	:	Microgrid Technologies
PS	:	Power Systems
PED	:	Power Electronics and Drives
CI	:	Control and Instrumentation
CADM	:	Computer Aided Design and Manufacturing
DMS	:	Design and Measurement Systems
DT	:	Design Trends
TES	:	Thermal Energy Sources
QM	:	Quality Management
CTM	:	Construction Technology and Management
IE	:	Infrastructure Engineering
GTSE	:	Green Technology and Sustainability Engineering
CSE	:	Computer Science and Engineering
ECE	:	Electronics and Communications Engineering

EE	:	Electrical Engineering
SD	:	Software Development
ME	:	Mechanical Engineering
ICE	:	Instrumentation and Control Engineering
CE	:	Civil Engineering
UHV	:	Universal Human Values

Acronyms for Course / Paper Groups and Codes:

BS	:	Basic Science
HS	:	Humanities, Social Science
MS	:	Management Studies
ES	:	Engineering Science
MC	:	Mandatory Courses
PC	:	Programme Core, that is course / paper offered in the discipline of the programme as a compulsory paper.
PCE	:	Programme Core Elective, that is elective course / paper offered in the discipline of the programme.
EAE/OAE	:	Emerging Area Elective / OpenArea Elective offered in the institution
CIC	:	Computer Science / IT Core
CIE	:	Computer Science / IT Elective
ECC	:	Electronics Core
ECE	:	Electronics Elective
EEC	:	Electrical Core
EEE	:	Electrical Elective
ICC	:	Instrumentation Core
ICE	:	Instrumentation Elective
MEC	:	Mechanical Core
MEE	:	Mechanical Elective
CEC	:	Civil Core
CEE	:	Civil Elective
MAC	:	Automation Core
MAO	:	Automation Open Elective

Definitions:

Batch: The batch of the student shall mean the year of the first time enrolment of the students in the programme of study in the first semester. Lateral entry students admitted in the 3rd semester / 2nd year shall be designated as students admitted in the previous batch as they are admitted one year later. A student re-admitted in a programme of study in a lower / later batch shall be considered as the student of the original batch for the purpose calculation of duration of study (lateral entry o readmission due to academic break).

Programme of study shall mean Bachelor of Technology.

Major / Primary specialization / discipline shall mean the discipline in which the student is admitted / upgraded or transferred.

Minor specialization shall mean the specializations earned through the EAE or OAE route subject to fulfilment of requirements specified in the scheme of study for the concerned minor specialization.

Other Acronyms:

PCC	:	Programme Coordination Committee
APC	:	Academic Programme Committee comprising of all faculty of the department / institutions and as defined in the implementation rules and the Ordinance 11 of the University.
L	:	Number of Lecture hours per week
T/P	:	Number of Tutorial / Practical Hours per week
C	:	Number of credits assigned to a course / paper
COE	:	Controller of Examinations of the Examinations Division of the University.
SGPA/CGPA	:	Semester/Cumulative Grade Point Average.
NUES	:	Non University Examination System - No term end examination shall be held. The evaluation shall be conducted as per the scheme of examinations as described in the scheme of study.

FIRST YEAR

Common Scheme and Syllabus for All

Bachelor of Technology Programmes of Study under the aegis of University School of Information and Communication Technology offered at Affiliated Institutions of the University

In light of the eligibility condition specified in the **AICTE Process Handbook 2022-23** (Page Nos 89 and 90), the **Chemistry Papers BS-121 / BS-120 entitled "Basic Chemistry"** shall be offered to students admitted from Academic Session 2022-23 (in the 1st/ 2ndSemester) in lieu of **Chemistry Papers BS-103 / BS-104 entitled "Applied Chemistry".**This shall be offered only to students who have not studied Chemistry at 10+2 Level and are admitted to the following disciplines only:

1) Computer Science and Engineering (CSE)
2) Information Technology (IT)
3) Computer Science and Technology (CST)
4) Information Technology and Engineering (ITE)
5) Electronics and Communications Engineering (ECE)
6) Electrical Engineering (EE)
7) Electrical and Electronics Engineering (EEE)
8) Instrumentation and Control Engineering (ICE)
9) Computer Science and Engineering (Artificial Intelligence) (CSE-AI)
10) Computer Science and Engineering (Artificial Intelligence and Machine Learning) (CSE-AIML)
11) Computer Science and Engineering (Data Science) (CSE-DS)
12) Computer Science and Engineering (Internet of Things) (CSE-IoT)
13) Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) (CSE-ICB)
14) Computer Science and Engineering (Networks) (CSE-Net)
15) Computer Science and Engineering (Cyber Security) (CSE-CS)

Note: The corresponding practical paper (BS-155 / BS-156) shall be unchanged.
(Addition from Academic Session 2022-23)

First Semester					
Group	**Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
 ES BS	 ES-101 BS-103/BS-121[#]	*Any one of the following: Programming in 'C' Applied Chemistry / Basic Chemistry[#]	3	-	3
BS	BS-105	Applied Physics – I	3	-	3
 ES BS	 ES-107 BS-109	*Any one of the following: Electrical Science Environmental Studies	3	-	3
BS	BS-111	Applied Mathematics – I	4	-	4
 HS HS HS	 HS-113 HS-115 HS-117	**Group 1 or Group 2 shall be offered: Group 1: Communications Skills OR Group 2: Indian Constitution*** Human Values and Ethics***	 3 2 1	 - 	 3 2 1
ES	ES-119	Manufacturing Process	4	-	4
Practical/Viva Voce					
BS	BS-151	Physics-I Lab	-	2	1
  ES BS	 ES-153 BS-155	Any of the following corresponding to the theory paper offered: Programming in 'C' Lab Applied Chemistry	-	2	1
ES	ES-157	Engineering Graphics-I	-	4	2
  ES BS	 ES-159 BS-161	Any of the following corresponding to the theory paper offered: Electrical Science Lab Environmental Studies Lab	-	2	1
Total			**20**	**10**	**25**

*For a particular batch of a programme of study one out of these two papers shall be taught in the first semester while the other shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper in the second semester. The institution shall decide which paper to offer in which semester.

**For a particular batch of a programme of study either the paper on "Communications Skills" (Group 1), or Group 2: papers ("Indian Constitution" and "Human values and ethics") shall be taught in the first semester while the other group shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper(s) in the second semester. The institution shall decide which paper group to offer in which semester.

*****<u>NUES</u>:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

#The students who have not studied Chemistry at 10+2 level shall be offered BS-121 in lieu of BS-103, as applicable in applicable disciplines. (Addition from the Academic Session 2022-23)

Group	Code	Paper	L	P	Credits
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2

***<u>NUES</u>:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall undergo training or participate in the activities for the period of 3rd semester to 6th semester only

Second Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES BS	ES-102 BS-104/BS-120#	*Any one of the following: Programming in 'C' Applied Chemistry / Basic Chemistry#	3	-	3
BS	BS-106	Applied Physics – II	3	-	3
ES BS	ES-108 BS-110	*Any one of the following: Electrical Science Environmental Studies	3	-	3
BS	BS-112	Applied Mathematics – II	4	-	4
HS	HS-114	**Group 1 or Group 2 shall be offered: Group 1: Communications Skills OR	3	-	3
HS HS	HS-116 HS-118	Group 2: Indian Constitution*** Human Values and Ethics***	2 1		2 1
ES	ES-114	Engineering Mechanics	3	-	3
Practical/Viva Voce					
BS	BS-152	Physics-II Lab	-	2	1
ES BS	ES-154 BS-156	*Any of the following corresponding to the theory paper offered: Programming in 'C' Lab Applied Chemistry	-	2	1
ES	ES-158	Engineering Graphics-II	-	2	1
ES BS	ES-160 BS-162	*Any of the following corresponding to the theory paper offered: Electrical Science Lab Environmental Studies Lab	-	2	1
ES	ES-164	Workshop Practice		4	2
Total			**19**	**12**	**25**

*For a particular batch of a programme of study one out of these two papers shall be taught in the first semester while the other shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper in the second semester. The institution shall decide which paper to offer in which semester.

**For a particular batch of a programme of study either the paper on "Communications Skills" (Group 1), or Group 2: papers ("Indian Constitution" and "Human values and ethics") shall be taught in the first semester while the other group shall be taught in the 2nd semester. Students who have to re-appear can only reappear in the odd semester if originally offered to the student in the 1st semester and similarly for the students who study the paper(s) in the second semester. The institution shall decide which paper group to offer in which semester.

*****NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

#The students who have not studied Chemistry at 10+2 level shall be offered BS-120 in lieu of BS-104, as applicable in applicable disciplines. (Addition from the Academic Session 2022-23)

BRIDGE COURSES FOR THE B.TECH LATERAL ENTRY STUDENTS

All the Lateral Entry students of B.Tech., who are directly admitted in the 2nd Year / 3rd Semester of the Progarmme of Study, have to pass the following bridge courses.

Paper Code	Paper Name	L/P
BC-181	Bridge Course in Mathematics	3
BC-183	Bridge Course in Programming in C	3

Implementation Rules for Bridge Courses:

1. The institutions are required to conduct the classes for the above bridge courses in the 3rd Semester along with the classes of the other courses.
2. These papers have to be qualified by the students.
3. For these papers examination shall be conducted by the concerned subject teacher as NUES, the same shall be transferred to Examination Division of the University.
4. The degree to be awarded to the student only subject to the acquiring qualifying grade/marks in the bridge courses and the minimum credits in the regular courses of the scheme of study as prescribed.
5. These Courses shall be qualifying in nature; they shall not be included for calculation of CGPA. The qualifying marks shall be 40 marks in each paper.
6. A separate marksheet will be issued by the Examination Division of the University for the Bridge Course.

PaperCode: ES-101 / ES-102	Paper: Programming in 'C'	L	T/P	C
		3	-	3

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in 'C'.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in 'C'.
3:	To impart knowledge about using arrays, pointers, files, union and structures to develop algorithms and programs in 'C'.
4:	To impart knowledge about how to approach for dividing a problem into sub-problems and solve the problem in 'C'.

Course Outcomes (CO):

CO1	Ability to develop simple algorithms for arithmetic and logical problems and implement them in 'C'.
CO2	Ability to implement conditional branching, iteration and recursion and functions in 'C'
CO3	Ability to use arrays, pointers, union and structures to develop algorithms and programs in 'C'.
CO4	Ability to decompose a problem into functions and synthesize a complete program using divide and conquer approach in 'C'.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Computer system, components of a computer system, computing environments, computer languages, creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme. Algorithms: Representation using flowcharts, pseudocode.
Introduction to C language: History of C, basic structure of C programs, process of compiling and running a C program, C tokens, keywords, identifiers, constants, strings, special symbols, variables, data types, I/O statements. Interconversion of variables.
Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators, bitwise and conditional operators, special operators, operator precedence and associativity, evaluation of expressions, type conversions in expressions.[8Hrs][T2]

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.
Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays.
Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.
Strings: Arrays of characters, variable length character strings, inputting character strings, character library functions, string handling functions. [8Hrs] [T2]

Unit III

Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, functions returning pointers, Dynamic memory allocation. Pointers to functions. Pointers and Strings
Structures and unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self-referential structures, unions, typedef, enumerations.
File handling: command line arguments, File modes, basic file operations read, write and append.
Scope and life of variables, multi-file programming. [8Hrs][T2]

Unit IV

C99 extensions. 'C' Standard Libraries: stdio.h, stdlib.h, assert.h, math.h, time.h, ctype.h, setjmp.h, string.h, stdarg.h, unistd.h [3Hrs] [T1, R8]
Basic Algorithms: Finding Factorial, Fibonacci series, Linear and Binary Searching, Basic Sorting Algorithms- Bubble sort, Insertion sort and Selection sort. Find the square root of a number, array order reversal, reversal of a string [7Hrs][T1]

Textbooks:

1. *How to solve it by Computer* by R. G. Dromey, Prentice-Hall India EEE Series, 1982.
2. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Programming Logic & Design* by Tony Gaddis, Pearson, 2nd Ed. 2016.
2. *Programming Logic and Design* by Joyce Farrell, Cengage Learning, 2015.
3. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
4. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
5. *Structure and Interpretation of Computer Programs* by Harold Abelson and Gerald Sussman with Julie Sussman, MIT Press, 1985.
6. *How to Design Programs* by Matthias Felleisen, Robert Bruce Findler, Matthew Flatt, and Shriram Krishnamurthi, MIT Press, 2018.
7. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).
8. *ISO/IEC 9899:1999. International Standard for Programming Languages – C (ISO/IEC 9899)* by American National Standards Institute, Information Technology Industry Council, 2000 (C99).
9. *INCITS/ISO/IEC 9899-2011.American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 2012 (C11).

PaperCode: BS-103 / BS-104	Paper: Applied Chemistry	L	T/P	C
		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand the fuels and their uses.
2:	To understand phase rule and its applications. Also, to understand the properties and industrial applications of polymers.
3:	To understand the methods used to make pure water.
4:	To understand the chemical aspects of corrosion and gain a basic understanding about the principles of Green Chemistry and Nano-chemistry.

Course Outcomes (CO):

CO1	Ability to use fuels and perform energy conversion calculations.
CO2	Understand the phase rule and its applications. Also, to understand the properties and industrial applications of polymers.
CO3	Ability to analyse water and use technologies to purify it.
CO4	Understand the chemical aspects of corrosion and its prevention. Also, to understand the basics of Green Chemistry and Nano-chemistry.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	1	1	-	1	1	-	1

Unit I

Fuels: Classification and Characteristics of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, calorific values of fuels, determination of calorific values using Bomb calorimeter, Boy's calorimeter, theoretical calculation of calorific value using Dulong formula and numericals of Calorific values. Types of fuels: - Solid: Coal, proximate and ultimate analysis of coal and numericals, carbonisation of coal in Otto-Hoffman oven with recovery of by-products, metallurgical coke; Liquid: Petroleum products --- refining, cracking-thermal and catalytic, knocking characteristics, Octane and Cetane rating; Gaseous: Natural Gas (NG), CNG, LPG, Coal gas, Oil gas, Producer gas, Water gas; Combustion of fuels numericals. [9Hrs] [T1]

Unit II

Phase rule: Terms used in Gibb's Phase rule, phase diagram and its applications for study of one-component systems: Water and Sulphur and two-component systems: Lead-Silver and Zinc-Magnesium.

Polymers: Classification, functionality and their types; Plastics: Synthesis (reactions) and properties of Polyethylene Plastics (Addition polymers) ---low-density polyethene (LDPE), high-density polyethylene(HDPE), linear low density polyethylene(LLDPE) and ultra-high molecular weight polyethylene (UHMWPE); Vinyl Plastics (Condensation polymers) -Nylons, Phenol-formaldehyde resins(Bakelite) and Glyptal; Speciality Polymers: Engineering thermoplastics, Conducting polymers, Electroluminescent polymers, liquid crystalline polymers and biodegradable polymers. [9Hrs][T1, T2]

Unit III

Water: Introduction, water quality standards, physical, chemical and biological characteristics; hardness of water, disadvantages of hardness, determination of hardness (EDTA method) and related numerical questions. Alkalinity and its determination; Boiler problems with hard water and their prevention: Scale and sludge formation, boiler corrosion, caustic embrittlement, priming and foaming, boiler water treatment –internal or in-situ: carbonate and phosphate conditioning, colloidal and Calgon conditioning; external treatment: (a) Lime soda process and related numericals (b) Zeolite process and numericals, (c) Ion-exchange process. Municipal water supply – its treatment and disinfection using break -point chlorination. Desalination, Reverse Osmosis, Electrodialysis and defluoridation of water. [9Hrs][T1, T2]

Unit IV

Corrosion and its Control: Definition, effects, theory (mechanisms): dry/chemical, wet/electrochemical corrosion, Pilling-Bedworth ratio; Types of corrosion: Galvanic corrosion, Soil corrosion, Pitting corrosion, Concentration cell or Differential Aeration corrosion, Stress corrosion; Mechanism of rusting of iron, Passivity. Factors influencing corrosion; protective measures: galvanization, tinning, cathodic protection, sacrificial anodic protection; electroplating and prevention of corrosion through material selection and design.

Green Technology and Green Chemistry

Twelve Principles of Green Chemistry, Zero Waste Technology, Atom economy, Use of alternative feedstock, innocuous reagents, alternative solvents, designing alternative reaction methodology, minimising energy consumption.

Nano Chemistry: Nanomaterials: Properties, synthesis and surface characterization techniques BET and TEM and applications. [9Hrs][T1, T2]

Textbooks:

1. Applied Chemistry by Achyutananda Acharya and Biswajit Samantray, Pearson, 2017.
2. *Engineering Chemistry: Fundamentals and Applications* by Shikha Agarwal, Cambridge University Press, 2019.

References:

1. *Applied Chemistry: A Textbook of Engineers and Technologists* by O. V. Roussk and H. D. Gesser, Springer, 2013.
2. Engineering Chemistry by Raghupati Mukhopadhyay and Sriparna Datta, New Age Int. (P0 Ltd., 2007.
3. *Engineering Chemistry* by K. Shesha Maheswaramma and Mridula Chugh, Pearson, 2017.
4. *Basic Engineering Chemistry* by S.S. Dara, A. K.Singh, and Abhilasha Asthana, S. Cand and Co., 2012.
5. Engineering Chemistry by K. N. Jayaveera, G.V. Subba Reddy, and C. Ramachandraiah, McGraw Hill, 2016.
6. *Engineering Chemistry* by O. G. Palanna, McGraw-Hill, 2017.
7. *Textbook of Engineering Chemistry* by Jaya Shree Anireddy, Wiley, 2017.
8. *Engineering Chemistry* byE.R. Nagarajan and S. Ramalingam, Wiley, 2017.

PaperCode: BS-121 / BS-120	Paper: Basic Chemistry	L	T/P	C
Year of Inclusion: 2022-23		**3**	**-**	**3**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand the fuels and their uses.
2:	To lay foundation for the application of engineering materials such as cement and glass Also, to understand the properties and industrial applications of polymers.
3:	To understand the methods used to make pure water.
4:	To understand the chemical aspects of corrosion.

Course Outcomes (CO):

CO1	Ability to use fuels and perform energy conversion calculations.
CO2	Course will impart knowledge about some important engineering materials such as cement and glass. It will also enable the students to understand the properties and industrial applications of polymers.
CO3	Ability to analyse water and use technologies to purify it.
CO4	Students will be able to understand the chemical aspects of corrosion and its prevention.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	1	1	-	1	1	-	1

Unit I

Fuels: Classification and Characteristics of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, calorific values of fuels, determination of calorific values using Bomb calorimeter, Boy's calorimeter, theoretical calculation of calorific value using Dulong formula and numericals of Calorific values. Types of fuels: - Solid: Coal, proximate and ultimate analysis of coal and numericals, carbonisation of coal in Otto-Hoffman oven with recovery of by-products, metallurgical coke; Liquid: Petroleum products --- mining and refining of petroleum, knocking, numericals based on combustion of fuels (excluding flue gas analysis) . [9Hrs] [T1]

Unit II

Engineering Materials: Portland Cement: manufacturing by Rotary Kiln, role of gypsum, chemistry of setting and hardening of cement. Glass: manufacturing by tank furnace, significance of annealing, types and properties of soft glass, hard glass, borosilicate glass. Polymers: Basic concepts & terminology, classification and functionality of polymers, Properties and applications of (excluding synthesis): polyethylene, polymethacrylate, nylon, bakelite, polycarbonate, conducting polymers, liquid crystalline polymers, biodegradable polymers. [9Hrs][T1, T2]

Unit III

Water: Introduction, water quality standards, physical, chemical and biological characteristics; hardness of water, disadvantages of hardness, determination of hardness (EDTA method) and related numerical questions, Alkalinity of water and related numericals. Boiler problems with hard water and their prevention: Scale and sludge formation, boiler corrosion, caustic embrittlement, priming and foaming, boiler water treatment –internal or in-situ: carbonate and phosphate conditioning, colloidal and Calgon conditioning; external treatment: (a) Lime soda process and related numericals (b) Zeolite process and numericals (c) Ion-exchange process. Desalination, Reverse Osmosis, Electrodialysis. [9Hrs] [T1, T2]

Unit IV

Corrosion and its Control: Definition, effects, theory (mechanisms): dry/chemical, wet/electrochemical corrosion, Pilling-Bedworth ratio; Types of corrosion: Galvanic corrosion, Soil corrosion, Pitting corrosion, Concentration cell or Differential Aeration corrosion, Stress corrosion; Passivity. Factors influencing corrosion; protective measures: galvanization, cathodic protection, sacrificial anodic protection; electroplating. [9Hrs] [T1, T2]

Textbooks:

1. *Engineering Chemistry: Fundamentals and Applications* by Shikha Agarwal, Cambridge University Press, 2019.
2. *Engineering Chemistry by Jain & Jain, Dhanpat Rai Publication Company, 2021 (Seventeenth Edition).*

References:

1. *Applied Chemistry: A Textbook of Engineers and Technologists* by O. V. Roussk and H. D. Gesser, Springer, 2013.
2. Engineering Chemistry by Raghupati Mukhopadhyay and Sriparna Datta, New Age Int. (P0 Ltd., 2007.
3. *Engineering Chemistry* by K. Shesha Maheswaramma and Mridula Chugh, Pearson, 2017.
4. *Basic Engineering Chemistry* by S.S. Dara, A. K.Singh, and Abhilasha Asthana, S. Cand and Co., 2012.
5. Engineering Chemistry by K. N. Jayaveera, G.V. Subba Reddy, and C. Ramachandraiah, McGraw Hill, 2016.
6. *Engineering Chemistry* by O. G. Palanna, McGraw-Hill, 2017.
7. *Textbook of Engineering Chemistry* by Jaya Shree Anireddy, Wiley, 2017.
8. *Engineering Chemistry* byE.R. Nagarajan and S. Ramalingam, Wiley, 2017.

PaperCode: BS-105	Paper: Applied Physics - I	L	T/P	C
		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand thermodynamic principles.
2:	To understand and model oscillations and waves.
3:	To understand and model interference, diffraction and polarization phenomenon.
4:	To understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO):

CO1	Ability to apply thermodynamic principles to solution of engineering problems.
CO2	Ability to understand and model oscillations and waves.
CO3	Ability to understand and model interference, diffraction and polarization phenomenon.
CO4	Ability to understand and appreciate relativistic systems and Lasers.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	2	2	3	3	2	-	-	-	1	1	-	2
CO2	2	2	3	3	2	-	-	-	1	1	-	2
CO3	2	2	3	3	2	-	-	-	1	1	-	2
CO4	2	2	3	3	2	-	-	-	1	1	-	2

Unit I

Introduction to Thermodynamics: Fundamental Ideas of Thermodynamics, The Continuum Model, The Concept of a “System’”, “State”, “Equilibrium”, “Process’”. Equations of state, Heat, Zeroth Law of Thermodynamics, Work, first and second laws of thermodynamics, entropy
[8Hrs]

Unit II

Waves and Oscillations: Wave motion, simple harmonic motion, wave equation, superposition principle. Introduction to Electromagnetic Theory: Maxwell’s equations. work done by the electromagnetic field, Poynting’s theorem, Momentum, Angular momentum in electromagnetic fields, Electromagnetic waves: the wave equation, plane electromagnetic waves, energy carried by electromagnetic waves [8Hrs]

Unit III

Interference: Interference by division of wave front (Young's double slit experiment, Fresnel's biprism), interference by division of amplitude (thin films, Newton's rings, Michelson's interferometer), Coherence and coherent sources

Diffraction: Fraunhofer and Fresnel diffraction; Fraunhofer diffraction for Single slit, double slit, and N-slit (diffraction grating), Fraunhofer diffraction from a circular aperture, resolving power and dispersive power of a grating, Rayleigh criterion, resolving power of optical instruments

Polarization: Introduction to polarization, Brewster's law, Malu's law, Nicol prism, double refraction, quarter-wave and half-wave plates, optical activity, specific rotation, Laurent half shade polarimeter. [12Hrs]

Unit IV

Theory of relativity: The Michelson-Morley Experiment and the speed of light; Absolute and Inertial frames of reference, Galilean transformations, the postulates of the special theory of relativity, Lorentz transformations, time dilation, length contraction, velocity addition, mass energy equivalence. Invariance of Maxwell's equations under Lorentz Transformation.

Introduction to Laser Physics: Introduction, coherence, Einstein A and B coefficients, population inversion, basic principle and operation of a laser, the He-Ne laser and the Ruby laser [12Hrs]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury, McGraw-Hill, 2017.
2. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9^{th} Edition , Cengage, 2017

References:

1. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.
2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.
3. *Optics* by Ajoy Ghatak, McGraw Hill, 2020.

PaperCode: ES-107 / ES-108	Paper: Electrical Science	L	T/P	C
		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge of the basics electrical engineering.
2:	To impart knowledge of the working of RLC circuits.
3:	To impart basic knowledge about filters and magnetic circuits.
4:	To impart basic knowledge about electrical machines.

Course Outcomes (CO):

CO1	Ability to understand and use Kirchpff's Laws to solve resistive circuit problems.
CO2	Ability to analyse resistive, inductive and capacitive circuits for transient and steady state sinusoidal solutions.
CO3	Understand the first order filters and magnetic circuits.
CO4	Understand the design of electrical machines.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	3	-	-	-	1	1	1	2
CO2	3	3	3	3	3	-	-	-	1	1	1	2
CO3	3	3	3	3	3	-	-	-	1	1	1	2
CO4	3	3	3	3	3	-	-	-	1	1	1	2

Unit - I

DC Circuits: Passive circuit components, Basic laws of Electrical Engineering, Temperature Resistance Coefficients. voltage and current sources, Series and parallel circuits, power and energy, Kirchhoff's Laws, Nodal & Mesh Analysis, delta-star transformation, superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem. Time domain analysis of first Order RC & LC circuits.
[9Hrs] [T1]

Unit - II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections. [9Hrs] [T1]

Unit - III

D. C. Generators & Motors: Principle of operation of Generators & Motors, Speed Control of shunt motors, Flux control, Rheostatic control, voltage control, Speed control of series motors.

A. C. Generators & Motors: Principle of operation, Revolving Magnetic field, Squirrel cage and phase wound rotor, Starting of Induction motors, Direct on line and Star Delta starters, Synchronous machines. [9Hrs [T1]]

Unit - IV:

Transformers: Construction and principle of operation, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.
Measuring Instruments: Electromagnetism, Different Torques in Indicating instruments, Moving Iron Instruments: Construction & Principle, Attraction and Repulsion type; Moving Coil instruments: Permanent Magnet type; Dynamometer type Instruments. [9Hrs] [T1]

Textbooks:
1. *Electrical Engineering Fundamentals* by Vincent Del Toro, PHI (India), 1989

References:
1. *An Introduction to Electrical Science* by Adrian Waygood, Routledge, 2^{nd} Ed. 2019.
2. *Electrical Circuit Theory and Technology* by John Bird, Elsevier, 2007.
3. *Principles and Applications of Electrical Engineering* by Giorgio Rizzoni, MacGraw-Hill, 2007.
4. *Electrical Engineering* by Allan R. Hambley, Prentice-Hall, 2011.
5. *Hughes Electical & Electronic Technology* by Edward Hughes revised by Hohn Wiley, Keith Brown and Ian McKenzie Smith, Pearson, 2016.
6. *Electrical and Electronics Technology* by E. Hughes, Pearson, 2010.
7. Basic Electrical Engineering by D.C. Kulshrestha, McGraw-Hill, 2009.
8. Basic Electrical Engineering by D. P. Kothai and I.J. Nagrath, McGraw-Hill, 2010.

PaperCode:BS-109 / BS-110	Paper: Environmental Studies	L	P	C
		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The course is designed to impart basic knowledge of the environment and its components.
2:	The course deals in creating awareness about the energy resources and current environmental problems faced by the world.
3:	To understand and learn about environment pollution, related case studies and measures taken for control to pollution.
4:	To understand and explore different approaches of conserving and protecting environment for the benefit of society.

Course Outcomes (CO):

CO1	Environmental Studies course will provide necessary information and knowledge about the various aspects of environment, ecosystems and related biodiversity.
CO2	Students will be able to learn and understand about the availability and sustainable use of resources, environmental problems and their short term and long term impacts to humans.
CO3	Course will help them to learn about environmental policies and protocols, social issues and role of human in conservation and protection of environment.
CO4	Overall, course will help students to develop skills and ability of understanding environment- human relationship.

Course Outcomes (CO to Programme Outcomes (PO)) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	-	1	1	-	-	3	3	2	1	1	1	1
CO2	-	1	1	-	-	3	3	2	1	1	1	1
CO3	-	1	1	-	-	3	3	2	1	1	1	1
CO4	-	1	1	-	-	3	3	2	1	1	1	1

Unit I

Fundamentals: The Multidisciplinary nature of environmental studies: Definition, components, scope and importance, need for public awareness; Natural Resources.
Ecosystems: Concept, Structure and function of an ecosystem, Types, Functional Components, Different ecosystems, biogeochemical cycles.
Biodiversity: Introduction to biodiversity, biogeographical classification, India as a mega diversity nation, endangered and endemic species of India, threats to biodiversity and conservation of biodiversity. Bioprospecting and Biopiracy. [10Hrs] [T1,T2]

Unit III

Environmental Pollution: (a) Air Pollution: Source, Types, effects on biosphere and Meterology, Air Quality, Control. (b) Water Pollution: Types and Sources. (c) Soil Pollution: Types and Control. (d)

Noise Pollution: Effect, Control (e) Thermal Pollution. (f) Radiation Pollution (g) Solid waste Management, (h) Pollution Prevention, (i) Disaster Management [10Hrs][T1,T2]

Unit III

Social Issues and Environment: Concept of Sustainable Development; Urban problem related to energy; Water Conservation; Wasteland reclamation; Resettlement and Rehabilitation; Climate Change; Nuclear Accidents; Consumerism and Waste Products; Laws related to Environment, Pollution, Forest and Wild life; Environmental Impact Assessment. [8Hrs] [T1,T2]

Unit IV

Human Population and Environment: Population Growth, Human Rights, Family Welfare Programmes, Environment and Human Health, HIV/AIDS, Women and Child Welfare, Role of IT. [8Hrs] [T1,T2]

Textbooks:
1. *Environmental Studies* by AninditaBasak, Pearson, 2009.
2. *Environmental Studies*: Simplified by Benny Joseph, McGraw-Hill, 2017.

References:
1. *Environmental Studies* by D. L. Manjunath, Pearson, 2007.
2. *Environmental Studies* by Anil Kumar De and Arnab Kumar De, New Age Int. (P) Ltd, Publishers, 2005.
3. *Companion to Environmental Studies*edited by Coel Castree, Mike Hulme, and James D. Proctor, Routledge, 2018.
4. *Environmental Studies* by Deepa Sharma and Bhupendra Singh Chabbra, New Age Int. (P) Ltd, Publishers, 2007.
5. *Environmental Studies: Simplified* by Raj Kumar Singh, McGraw-Hill, 2012.
6. *Basics of Environmental Studies* by U. K. Khare, McGraw-Hill, 2014.

PaperCode: BS-111	Paper: Applied Mathematics - I	L	T/P	C
		4	-	4

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand use series, differential and integral methods to solve formulated engineering problems.
2:	To understand use Ordinary Differential Equations to solve formulated engineering problems.
3:	To understand use linear algebra to solve formulated engineering problems.
4:	To understand use vector calculus to solve formulated engineering problems.

Course Outcomes (CO):

CO1	Ability to use series, differential and integral methods to solve formulated engineering problems.
CO2	Ability to use Ordinary Differential Equations to solve formulated engineering problems.
CO3	Ability to use linear algebra to solve formulated engineering problems.
CO4	Ability to use vector calculus to solve formulated engineering problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Partial derivatives, Chain rule, Differentiation of Implicit functions, Exact differentials. Maxima, Minima and saddle points, Method of Lagrange multipliers. Differentiation under Integral sign, Jacobians and transformations of coordinates. [8Hrs][T2]

Unit II

Ordinary Differential Equations (ODEs): Basic Concepts. Geometric Meaning of y'= f(x, y). Direction Fields, Euler's Method, Separable ODEs. Exact ODEs. Integrating Factors, Linear ODEs. Bernoulli Equation. Population Dynamics, Orthogonal Trajectories. Homogeneous Linear ODEs with Constant Coefficients. Differential Operators. Modeling of Free Oscillations of a Mass–Spring System, Euler–Cauchy Equations. Wronskian, Nonhomogeneous ODEs, Solution by Variation of Parameters.
Power Series Method for solution of ODEs: Legendre's Equation. Legendre Polynomials, Bessel's Equation, Bessels's functions Jn(x) and Yn(x). Gamma Function [12Hrs][T1]

Unit III

Linear Algebra: Matrices and Determinants, Gauss Elimination, Linear Independence. Rank of a Matrix. Vector Space. Solutions of Linear Systems and concept of Existence, Uniqueness, Determinants. Cramer's Rule, Gauss–Jordan Elimination. The Matrix Eigenvalue Problem.
Determining Eigenvalues and Eigenvectors, Symmetric, Skew-Symmetric, and Orthogonal Matrices. Eigenbases. Diagonalization. Quadratic Forms.Cayley – Hamilton Theorem (without proof)[10Hrs][T1]

Unit IV

Vector Calculus: Vector and Scalar Functions and Their Fields. Derivatives, Curves. Arc Length. Curvature. Torsion, Gradient of a Scalar Field. Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Line Integrals, Path Independence of Line Integrals, Double Integrals, Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Stokes Theorem. Divergence Theorem of Gauss. [10Hrs][T1]

Textbooks:
1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.
2. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013. (for Unit I)

References:
1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.
2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.

PaperCode:HS-113 / HS-114	Paper: Communications Skills	L	T/P	C
		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.

Course Objectives:

1:	To understand the communication system paradigm.
2:	To understand how language vocabulary can be increased and difference between Indian, British and American English.
3:	To understand how to write a business letter and make a speech.
4:	To improve grammar and sentence structure.

Course Outcomes (CO):

CO1	Ability to Communicate as an Individual and in a Group.
CO2	Ability to learn new words, differentiate between Indian, British and American English.
CO3	Ability to write business letters and make speeches.
CO4	Improved grammar and sentence structure.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	-	-	-	-	-	-	-	-	3	3	-	3
CO4	-	-	-	-	-	-	-	-	3	3	-	3

Unit I

Role and Importance of Communications, Attributes of Communications, Verbal and Non-Verbal Communications, Verbal Communications Skills, Non-verbal Communication Methods, Body Language, Barriers to Communications, Socio-psychological barriers, Inter-Cultural barriers, Overcoming barriers, Communication Mediums: Characterization and Choice of medium, Effective Communication: Correctness, Clarity, Conciseness, Courtesy, Group Communication: Meetings (types, purpose), Group Discussions, Conduct of Meeting, Participant Role, Making Presentations. [8Hrs][T1]

Unit II

Spoken and Written English: Attributes of spoken and written communication, Formal & Informal Communication, Variation in between Indian, British and American English. Etiquette and Manners: Personal Behaviour, Greetings, Introductions, Telephone Etiquette. Vocabulary Development: Dictionaries and Thesaurus, Words often confused, generally used one word substitutions, Comprehension. [8Hrs][T1]

Unit III

Letter writing: Planning the message, Planning Content, Structure, Language use, Layout, enquires and replies, asking for or giving quotations, Bargaining letters, Seller's reply, etc.; Complaints and Replies; Memos, Circulars and notices;
Papragraph Writing, Writing Scientific and Technical Reports: Types, Structure, Drafting and Delivering a Speech: Understanding the Environment, Understanding the Audience, Text preparing, Composition, Practicing, Commemorative Speeches, Welcome and Introduction, Farewell and Send-offs, Condolence [8Hrs][T1]

Unit IV

Articles: Indefinite, Definite; Tenses: Present, Past, Future, Perfect (Present, Past and Future), Tenses in conditional sentences; Active and Passive Voice: Formation, conversion; Direct and Indirect Speech, Degrees of Comparison, Common errors, Concepts of Learning and Listening [8Hrs][T1]

Textbooks:
1. *English Language Communication Skills* by Urmilla Rai, Himalaya Publishing House, 10th Ed., 2010.

References:
1. *Technical Communication: Principles and Practice* byMeenakshi Raman and Sangeeta Sharma, Oxford University Press, 2015.
2. *Communication Skills for Engineers* by C. Muralikrishna and Sunita Mishra, Pearson, 2011.
3. *Effective Technical Communication* by M. Ashraf Rizvi, McGraw-Hill, 2018.
4. *Business Communication: Skills, Concepts, and Applications* by P.D. Chaturvedi and Mukesh Chaturvedi, Pearson, 2013.
5. *Business Correspondence and Report Writing* by R.C. Sharma and Krishan Mohan, McGraw-Hill, 2016.
6. *English for Technical Communications* by Aysha Viswamohan, Tata McGraw-Hill, 2008.

PaperCode:HS-115 / HS-116	Paper: Indian Constitution	L	T/P	C
		2	-	2

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To create awareness among students about the Indian Constitution
2:	To create consciousness among students about democratic principles and enshrined in the Constitution of India

Course Outcomes (CO):

CO1	To understand institutional mechanism and fundamental values enshrined in the Constitution of India
CO2	To understand the inter-relation between Centre and State Government
CO3	To understand Fundamental Rights and Duties
CO4	To understand the structure and functions of judicial systems in the country.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	2	-	-	-	1
CO2	-	-	-	-	-	3	-	2	-	-	-	1
CO3	-	-	-	-	-	3	-	2	-	-	-	1
CO4	-	-	-	-	-	3	-	2	-	-	-	1

Unit I

Introduction to Constitution of India: Definition, Source and Framing of the Constitution of India. Salient features of the Indian Constitution. Preamble of the Constitution. [6Hrs]

Unit II

Fundamental Rights and Duties: Rights To Equality (Article 14-18). Rights to Freedom (Article 19-22). Right against Exploitation (Article 23-24). Rights to Religion and Cultural and Educational Rights of Minorities(Article 25- 30). The Directive Principles of State Policy – Its significance and application. Fundamental Duties – Necessary obligations and its nature, legal status and significance [6Hrs]

Unit III

Executives and Judiciary: Office of President, Vice President and Governor: Power and Functions, Parliament, Emergency Provisions-, President Rule; Union Judiciary: Appointment of Judges, Jurisdiction of the Supreme Court, State Judiciary: Power and functions, Writ Jurisdiction [6Hrs]

Unit IV

Center-States Relation: Is Indian Constitution Federalin Nature, Legislative relations between Union and States, Administrative Relations between Union and States, Financial Relations between Union and States [6Hrs]

Textbooks:

1. *Constitutional Law of India* by J.N Pandey, Central Law Publication, 2018.
2. *Introduction to the Indian Constitution of India* by D.D. Basu, PHI, New Delhi, 2021
3. *The Constitution of India* by P.M. Bakshi, Universal Law Publishing Co., 2020.

References:

1. *Indian Constitutional Law* by M.P. Jain, Lexis Nexis, 2013
2. *Constitution of India* by V.N. Shukla, Eastern Book Agency, 2014

PaperCode:HS-117/HS-118	Paper: Human Values and Ethics	L	P	C
		1	-	1

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, the examinations are to be conducted by the concerned teacher.

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives:

1:	To help students regulate their behavior in a professional environment as employees
2:	To make students aware of the impact of taking non-ethical engineering decisions.
3:	To understand that mind and desire control is needed for being ethical.
4:	To understand organizational culture and to adapt to varying cultures without compromising ethical values

Course Outcomes (CO):

CO1	Realize the importance of human values.
CO2	Understand that excessive desires of the mind make a person unethical and restless, while fewer desires lead to peace and professional progress
CO3	Assess different types of risks involved in unethical practices. Know various means of protesting against unethical practices.
CO4	Assess the benefits of restraining from unethical practices like bribery, extortion, nepotism, nexus between politicians and industrialists.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	3	-	3	1	1	-	1
CO2	-	-	-	-	-	3	-	3	1	1	-	1
CO3	-	-	-	-	-	3	-	3	1	1	-	1
CO4	-	-	-	-	-	3	-	3	1	1	-	1

Unit I

Human Values: Morals, Values, Ethics, Integrity, Work ethics, Service learning, Virtues, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Challenges in the work place, Spirituality [3Hrs]

Unit II

Engineering Ethics: Senses of engineering ethics, Variety of moral issues, Types of inquiries, Moral dilemma, Moral autonomy, Moral development (theories), Consensus and controversy, Profession, Models of professional roles, Responsibility, Theories about right action (Ethical theories), Self-control, Self-interest, Customs, Religion, Self-respect, Case study: Choice of the theory

Engineering as experimentation, Engineers as responsible experimenters, Codes of ethics, Industrial standards, A balanced outlook on law, Case study: The challenger [3Hrs]

Unit III

Safety definition, Safety and risk, Risk analysis, Assessment of safety and risk, Safe exit, Risk-benefit analysis

Sefety lessons from 'the challenger', Case study: Power plants,Collegiality and loyalty, Collective bargaining,
Confidentiality, Conflict of interests, Occupational crime, Human rights, Employee rights, Whistle blowing, Intellectual property rights. [4Hrs]

Unit IV

Globalization, Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership, Codes of ethics, Engineering council of India, Codes of ethics in Business Organizations [3Hrs]

Textbooks:

1. *A Textbook on Professional Ethics and Human Values*, by R. S. Naagarazan, New Age Publishers, 2006.

References:

1. *Professional Ethics and Human Values* by D. R. Kiran, McGraw-Hill, 2014.
2. *Engineering Ethics, by Charles E Harris and Micheal J Rabins, Cengage Learning Pub., 2012.*
3. *Ethics in Engineering, Mike Martin and Roland Schinzinger, McGraw Hill Pub., 2017.*
4. *Unwritten laws of Ethics and Change in Engineering by The America Society of Mechanical Engineers, 2015.*
5. *Engineering Ethics by Charles B. Fleddermann, Pearson, 2014.*
6. *Introduction to Engineering Ethics* by Mike W. Martin and Roland Schinzinger, McGraw-Hill, 2010.
7. *Engineering Ethics: Concept and Cases* by Charles E. Harris, Michael S. Pritchard and Michael J.Rabins, Cengage, 2009.
8. *Ethics in Engineering Practiceand Research* by Caroline Whitbeck, Cambridge University Press, 2007.

PaperCode: ES-119	Paper: Manufacturing Process	L	T/P	C
		4	-	4

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	The students will have basic understanding of various manufacturing processes. The students will have knowledge about casting process.
2:	The students will have understanding of joining processes.
3:	The students will have understanding of forging and sheet metal works.
4:	The students will have basic idea of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO):

CO1	Understand casting process.
CO2	Understand joining process.
CO3	Understand forging and sheet metal work.
CO4	Basic understanding of powder metallurgy and manufacturing of plastic components.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	1	1	2	-	-	-	-	-	1	1
CO2	2	1	1	1	2	-	-	-	-	-	1	1
CO3	2	1	1	1	2	-	-	-	-	-	1	1
CO4	2	1	1	1	2	-	-	-	-	-	1	1

Unit I

Definition of manufacturing, Importance of manufacturing towards technological and social economic development, Classification of manufacturing processes, Properties of materials.
Metal Casting Processes: Sand casting, Sand moulds, Type of patterns, Pattern materials, Pattern allowances, Types of Moulding sand and their Properties, Core making, Elements of gating system. Description and operation of cupola.
Working principle of Special casting processes - Shell casting, Pressure die casting, Centrifugal casting. Casting defects. [10Hrs]

Unit II

Joining Processes: Welding principles, classification of welding processes, Fusion welding, Gas welding, Equipments used, Filler and Flux materials. Electric arc welding, Gas metal arc welding, Submerged arc welding, Electro slag welding, TIG and MIG welding process, resistance welding, welding defects. [10Hrs]

Unit III

Deformation Processes: Hot working and cold working of metals, Forging processes, Open and closed die forging process. Typical forging operations, Rolling of metals, Principle of rod and wire drawing, Tube drawing. Principle of Extrusion, Types of Extrusion, Hot and Cold extrusion.
Sheet metal characteristics -Typical shearing operations, bending and drawing operations, Stretch forming operations, Metal spinning. [10Hrs]

Unit IV

Powder Metallurgy: Introduction of powder metallurgy process, powder production, blending, compaction, sintering
Manufacturing Of Plastic Components: Types of plastics, Characteristics of the forming and shaping processes, Moulding of Thermoplastics, Injection moulding, Blow moulding, Rotational moulding, Film blowing, Extrusion, Thermoforming. Moulding of thermosets- Compression moulding, Transfer moulding, Bonding of Thermoplastics. [10Hrs]

Textbooks:
1. *Manufacturing Technology: Foundry, Forming and Welding Volume 1*, P. N Rao, , McGrawHill, 5e, 2018.
2. *Elements of Workshop Technology Vol. 1 and 2* by Hajra Choudhury, Media Promoters Pvt Ltd.,2008.

References:
1. *Manufacturing Processes for Engineering Materials*, by Serope Kalpajian and Steven R.Schmid, Pearson Education, 5e, 2014.
2. *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems* by Mikell P. Groover, John Wiley and Sons, 4e, 2010 .
3. *Production Technology* by R.K.Jain and S.C. Gupta, Khanna Publishers. 16th Edition, 2001.

PaperCode: BS-151	Paper: Applied Physics - I Lab.	L	P	C
		-	2	1

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Applied Physics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. To determine the wavelength of sodium light by Newton's Rings.
2. To determine the wavelength of sodium light by Fresnel's biprism.
3. To determine the wavelength of sodium light using diffraction grating.
4. To determine the refractive index of a prism using spectrometer.
5. To determine the dispersive power of prism using spectrometer and mercury source.
6. To determine the specific rotation of cane sugar solution with the help of half shade polarimeter.
7. To find the wavelength of He-Ne laser using transmission diffraction grating.
8. To determine the numeral aperture (NA) of an optical fibre.
9. To plot a graph between the distance of the knife-edge from the center of the gravity and the time period of bar pendulum. From the graph, find (a) The acceleration due to gravity (b) The radius of gyration and the moment of inertia of the bar about an axis.
10. To determine the velocity of ultrasound waves using an ultrasonic spectrometer in a given liquid (Kerosene Oil).
11. To verify inverse square law.
12. To determine Planck's constant.

Note: Teacher's may use the prescribed books to choose the practicals in addition to above. Total 8 practicals minimum shall be performed by the students, they may be asked to do more. Atleast 4 experiments must be from the above list.

Textbook:
1. *B.Sc. Practical Physics* by C. L. Arora, S.Chand & Co., 2020.
2. *Practical physics* by R. K. Shukla and A. Srivastava, New Age Int. (P) Ltd., 2006.

<table>
<tr><td>PaperCode: ES-153 / ES-154</td><td>Paper: Programming in ‘C’ Lab.</td><td>L</td><td>P</td><td>C</td></tr>
<tr><td></td><td></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks</td></tr>
<tr><td colspan="5">Instructions:
1. The course objectives and course outcomes are identical to that of “Programming in ‘C’” as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students</td></tr>
</table>

1. Write a program to find divisor or factorial of a given number.

2. Write a program to find sum of a geometric series

3. Write a recursive program for tower of Hanoi problem

4. Write a recursive program to print the first m Fibonacci number

5. Write a menu driven program for matrices to do the following operation depending on whether the operation requires one or two matrices

   a. Addition of two matrices
   b. Subtraction of two matrices
   c. Finding upper and lower triangular matrices
   d. Transpose of a matrix
   e. Product of two matrices.

6. Write a program to copy one file to other, use command line arguments.

7. An array of record contains information of managers and workers of a company. Print all the data of managers and workers in separate files.

8. Write a program to perform the following operators on Strings without using String functions

   a. To find the Length of String.
   b. To concatenate two string.
   c. To find Reverse of a string.
   d. To copy one string to another string.

9. Write a Program to store records of a student in student file. The data must be stored using Binary File.Read the record stored in “Student.txt” file in Binary code.Edit the record stored in Binary File.Append a record in the Student file.

10. Write a programmed to count the no of Lowercase, Uppercase numbers and special Characters presents in the contents of text File.

Note:
1. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above.
2. In addition Two Mini Projects based on the skills learnt shall be done by the students. Teachers shall create the mini projects so that the same is not repeated every year. These mini projects may be done in a group not exceeding group size of 4 students.
3. Usage of IDE like Visual Studio Community Edition, Codeblocks, etc. are recommended.

<table>
<tr><td>PaperCode: BS-155 / BS-156</td><td>Paper: Applied Chemistry Lab.</td><td>L</td><td>P</td><td>C</td></tr>
<tr><td></td><td></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks</td></tr>
<tr><td colspan="5">Instructions:
1. The course objectives and course outcomes are identical to that of “Applied Chemistry” as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students</td></tr>
</table>

1. Determination of alkalinity of water sample.
2. Determination of hardness of water sample by EDTA method.
3. Determine the percentage composition of sodium hydroxide in the given mixture of sodium hydroxide and sodium chloride.
4. Determine the amount of oxalic acid and Sulphuric acid in one litre of solution, given standard sodium hydroxide and Potassium Permanganate.
5. Determine the amount of copper in the copper ore solution, provided hypo-solution (Iodometric Titration).
6. Determine the amount of chloride ions present in water using silver nitrate (Mohr’s Precipitation Method).
7. Determine the strength of MgSO4 solution by Complexometric titration.
8. Determine the surface tension of a liquid using drop number method.
9. Determine the viscosity of a given liquid (density to be determined).
10. Determine the cell constant of conductivity cell and titration of strong acid/strong base conductometrically.
11. To determine (a) λ max of the solution of KMnO4. (b) Verify Beer’s law and find out the concentration of unknown solution by spectrophotometer.
12. Determination of the concentration of iron in water sample by using spectrophotometer.
13. Determination of the concentration of Iron (III) by complexometric titration.
14. Proximate analysis of coal.
15. Determination of eutectic point and congruent melting point for a two component system by method of cooling curve.

References:

1. *Vogel’s Text Book of Quantitative Chemical Analysis* by G.H. Jefferey, J. Bassett, J. Mendham, and R.C. Denney, Logmaan Scientific & Technical, 1989
2. *Essentials of Experimental Engineering Chemistry* by S. Chawla, Dhanpat Rai & Co., 2008.
3. Experiments in Applied Chemistry by S. Ratan, S.K. KAtaria & Sons, 2003.
4. *Practical Chemistry* by O.P.Pandey, D. N. Bajpai and S. Giri, S.Chand & Co., 2005.
5. *Engineering Chemistry with Laboratory Experiments* by M. S. Kaurav, PHI Learning Pvt. Ltd., 2011.
6. *Laboratory Manual on Engineering Chemistry* by S. K. Bhasin, and Sudha Rani, Dhanpat Rai &Co., 2006.

Note:
1. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above.

PaperCode: ES-157	Paper: Engineering Graphics-I	L	P	C
		-	4	2

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn the introduction of Engineering graphics, various equipment used, various scales, dimensions and BIS codes used while making drawings for various streams of engineering disciplines.
2:	The students will learn theory of projections and projection of points.
3:	The students will learn projection of lines and projection of planes.
4:	The students will learn the projection of solid and development of surfaces

Course Outcomes (CO):

CO1	To understand the theory of projections and projection of points.
CO2	Ability to do line projections.
CO3	Ability to do plane projections.
CO4	Ability to do solid projections and development of surfaces

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I

Introduction: Engineering Graphics/Technical Drawing, Introduction to drawing equipments and use of instruments, Conventions in drawing practice. Types of lines and their uses, BIS codes for lines, technical lettering as per BIS codes, Introduction to dimensioning, Types, Concepts of scale drawing, Types of scales
Theory of Projections: Theory of projections, Perspective, Orthographic, System of orthographic projection: in reference to quadrants, Projection of Points, Projection in different quadrants, Projection of point on auxiliary planes. Distance between two points, Illustration through simple problems.

Unit II

Projection of Lines: Line Parallel to both H.P. and V.P., Parallel to one and inclined to other, Other typical cases: three view projection of straight lines, true length and angle orientation of straight line: rotation method, Trapezoidal method and auxiliary plane method, traces of line.

Unit III

Projection of Planes: Projection of Planes Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, Plane oblique to reference planes, traces of planes.
Planes Other than the Reference Planes: Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points and lines lying in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.

Unit IV

Projection of Solids: Projection of solids in first or third quadrant, Axis parallel to one and perpendicular to other, Axis parallel to one inclined to other, Axis inclined to both the principal plane, Axis perpendicular to profile plane and parallel to both H.P. and V.P., Visible and invisible details in the projection, Use of rotation and auxiliary plane method.

Development of Surface: Purpose of development, Parallel line, radial line and triangulation method, Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, Development of surface.

Note: The sheets to be created shall be notified by the concerned teacher.

Textbooks:

1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:

1. *Engineering Drawing* by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing* by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.

<table>
<tr><td>PaperCode: ES-159 / ES-160</td><td>Paper: Electrical Science Lab.</td><td>L</td><td>P</td><td>C</td></tr>
<tr><td></td><td></td><td>-</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks</td></tr>
<tr><td colspan="5">Instructions:
1. The course objectives and course outcomes are identical to that of “Electrical Science” as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students</td></tr>
</table>

1. To Design the circuit for a given load and selection of its various Components and instruments from the safety point of view

   OR

   To study different types of symbols and standard currently being used inelectrical engineering.
2. Study and applications of CRO for measurement of voltage, frequencyand phase of signals.
3. Connection of lamp by(1)Single Switch Method.(2) Two-way Switch Method.

   OR

   Performance comparison of fluorescent Tube & CFL Lamp.
3. To Verify Thevenin’s & Norton’s Theorem

   OR

   To Verify Superposition &Reciprocity Theorem.

   OR

   To Verify Maximum Power Transfer Theorem.
4. To Measure Power & Power Factor in a Single-Phase A.C Circuit usingThree Ammeters or three Voltmeters.
5. To Measure Power & Power Factor in a Balanced Three Phase Circuitusing Two Single Phase Wattmeters.
6. To study of Resonance in a series R-L-C or Parallel R-L-C Circuits.
7. To perform open circuit and short circuit test on 1-phase transformer.
8. Starting, Reversing and speed control of DC shunt Motor
9. Starting, Reversing and speed control of 3-phase Induction Motor
10. To Study different types of Storage Batteries & its charging system.
11. To Study different types of earthing methods including earth leakagecircuit breaker (GFCI)

Note:
1. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above.

PaperCode: BS-161 /BS-162	Paper: Environmental Studies Lab.	L	P	C
		-	2	1

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of "Environmental Studies" as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students

1. Determination of pH, conductivity and turbidity in drinking water sample.
2. Determination of pH and conductivity of soil/sludge samples.
3. Determination of moisture content of soil sample.
4. Determination of Total Dissolved Solids (TDS) of water sample.
5. Determination of dissolved oxygen (DO) in the water sample.
6. Determination of Biological oxygen demand (BOD) in the water sample.
7. Determination of Chemical oxygen demand (COD) in the water sample.
8. Determination of Residual Chlorine in the water sample.
9. Determination of ammonia in the water sample.
10. Determination of carbon dioxide in the water sample.
11. Determination of nitrate ions or sulphate ions in water using spectrophotometer.
12. Determination of the molecular weight of polystyrene sample using viscometer method.
13. Base catalyzed aldol condensation by Green Methodology.
14. Acetylation of primary amines using eco-friendly method.
15. To determine the concentration of particulate matter in the ambient air using High Volume Sampler.

Note:
1. For better understanding of various aspects of environment visits to local areas, depending upon easy access and importance may be planned to any nearby river, forest, grassland, hills and students should write a report based on their observations.
2. At least 8 Experiments out of the list shall be performed by the students. Teachers may introduce new experiments for the class in addition to above

References:

1. *Vogel's Text Book of Quantitative Chemical Analysis* by G.H. Jefferey, J. Bassett, J. Mendham, and R.C. Denney, Logmaan Scientific & Technical, 1989.
2. dst.gov.in/green-chem.pdf (monograph of green chemistry laboratory experiments).
3. *Essentials of Experimental Engineering Chemistry* by S. Chawla, Dhanpat Rai & Co., 2008.
4. Experiments in Applied Chemistry by S. Ratan, S.K. KAtaria & Sons, 2003.
5. *Principles of Environment Science: Enquiry and Applications* by W. Cunningham and M. A. Cunningha, Tata McGraw Hill, 2003.
6. *Perspectives in Environment Studies* by A. Kaushik and C. P. Kaushik, New Age Int. (P) Pub., 2013.

PaperCode: BS-106	Paper: Applied Physics - II	L	T/P	C
		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term-end examinations question paper.
2. The first unit will be compulsory and cover the entire syllabus. This question will have Five sub-parts, and the students will be required to answer any THREE parts of 5 marks each. This unit will have a total weightage of 15 marks.
3. Apart from unit 1 which is compulsory, the rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain up to 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course/paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To learn about the quantum nature of reality.
2:	To learn about quantum statistics and its significance.
3:	To understand the structures of crystals.
4:	To learn about the band theory of solids and properties and characteristics of diodes.

Course Outcomes (CO):

CO1	Understand and appreciate the quantum nature of reality.
CO2	Understand quantum statistics and its significance.
CO3	Understand Crystalline Structure.
CO4	Understand the band theory of solids and properties and characteristics of diodes.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	2	3	3	2	-	-	-	1	1	-	1
CO2	2	2	3	3	2	-	-	-	1	1	-	1
CO3	2	2	3	3	2	-	-	-	1	1	-	1
CO4	2	2	3	3	2	-	-	-	1	1	-	1

Unit I

Quantum Mechanics: Introduction: Wave particle duality, de Broglie waves, the experiment of Davisson and Germer, electron diffraction, physical interpretation of the wave function, properties, the wave packet, group and phase velocity, the uncertainty principle . The Schrödinger wave equation (1D), Eigen values and Eigen functions, expectation values, simple Eigen value problems – solutions of the Schrödinger's equations for the free particle, the infinite well, the finite well, tunneling effect, the scanning electron microscope, the quantum simple harmonic oscillator (qualitative), zero point energy. [8Hrs][T1,T2]

Unit II

Quantum Statistics: The need for statistics , statistical distributions: Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac statistics, their comparisons, Fermions and Bosons, Applications of quantum statistics: 1. Molecular speed and energies in an ideal gas; 2. The Black body spectrum, the failure of classical statistics to give the correct explanations – Bose-Einstein statistics applied to the Black Body radiation spectrum; Fermi-Dirac distribution, free electron theory, electronic specific heats, Fermi energy and average energy; Dying stars. [8Hrs][T1,T2]

Unit III

Crystal Structure: Types of solids, Unit cell, Types of crystals, Translation vectors, Lattice planes, Miller indices, Simple crystal structures, Interplaner spacing, Crystal structure analysis: Bragg's law, Laue method, Point defects: Schottcky and Frankel defects. [8Hrs][T1,T2]

Unit IV

Band Theory of Solids: Origin of energy bands in solids, motion of electrons in a periodic potential – the Kronig–Penny model (Qualitative). Brillouin zones, effective mass, metals, semi-conductors and insulators and their energy band structures. Extrinsic and Intrinsic semiconductors, doping – Fermi energy for doped and undoped semiconductors, the p-n junction (energy band diagrams with Fermi energy), the unbiased diode, forward and reverse biased diodes – tunnel diodes, zener diode, photo diode its characteristics, LED [8Hrs][T1,T2]

Textbooks:

1. *Concepts of Modern Physics (SIE)*by Arthur Beiser, Shobhit Mahajan, and S. Rai Choudhury, McGraw – Hill, 2017.

2. *Modern Physics* by Kenneth S. Krane, Wiley, 2020.

References:

1. *Physics for Scientists and Engineers* by Raymond A. Serway and John W. Jewett, 9^{th} Edition , Cengage, 2017

2. *Principles of Physics* by Robert Resnick, Jearl Walker and David Halliday, Wiley, 2015.

3. *Solid State Electronic Devices ,by* Streetman and Ben G Prentice Hall India Learning Private Limited; 2006

PaperCode: BS-112	Paper: Applied Mathematics - II	L	T/P	C
		4	-	4

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus.This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand Complex series methods.
2:	To understand Complex analysis
3:	To understand Fourier and Laplace methods
4:	To understand how to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO):

CO1	Ability to use Complex series methods.
CO2	Ability to use Complex analysis to solve formulated engineering problems
CO3	Ability to use Fourier and Laplace methods to solve formulated engineering problems
CO4	Ability to solve specific formulated engineering problems using PDE methods.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	3	3	3	1	-	-	-	-	-	1	2
CO2	2	3	3	3	1	-	-	-	-	-	2	2
CO3	2	3	3	3	1	-	-	-	-	-	2	2
CO4	2	3	3	3	1	-	-	-	-	-	2	2

Unit I

Complex Analysis – I : Complex Numbers and Their Geometric Representation, Polar Form of Complex Numbers. Powers and Roots, Derivative. Analytic Function, Cauchy–Riemann Equations. Laplace's Equation, Exponential Function, Trigonometric and Hyperbolic Functions. Euler's Formula, de'Moivre's theorem (without proof), Logarithm. General Power. Principal Value. Singularities and Zeros. Infinity,
Line Integral in the Complex Plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Derivatives of Analytic Functions, Taylor and Maclaurin Series. [10Hrs]

Unit II

Complex Analysis – II: Laurent Series, Residue Integration Method. Residue Integration of Real Integrals,
Geometry of Analytic Functions: Conformal Mapping, Linear Fractional Transformations (Möbius Transformations), Special Linear Fractional Transformations, Conformal Mapping by Other Functions, Applications: Electrostatic Fields, Use of Conformal Mapping. Modeling, Heat Problems, Fluid Flow. Poisson's Integral Formula for Potentials [10Hrs]

Unit III

Laplace Transforms: Definitions and existence (without proof), properties, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals and ODEs, Unit Step Function (Heaviside Function). Second Shifting Theorem (t-Shifting), Short Impulses. Dirac's Delta Function. Partial Fractions, Convolution. Integral Equations, Differentiation and Integration of Transforms. Solution of ODEs with Variable Coefficients, Solution of
Systems of ODEs. Inverse Laplace transform and its properties.
Fourier Analysis: Fourier Series, Arbitrary Period. Even and Odd Functions. Half-Range Expansions, Sturm–Liouville Problems. Fourier Integral, Fourier Cosine and Sine Transforms, Fourier Transform. Usage of fourier analysis for solution of ODEs. Inverse Fourier transform and its properties. [10Hrs]

Unit IV

Partial Differential Equations (PDEs): Basic Concepts of PDEs. Modeling: Vibrating String, Wave Equation. Solution by Separating Variables. Use of Fourier Series. D'Alembert's Solution of the Wave Equation. Characteristics. Modeling: Heat Flow from a Body in Space. Heat Equation:Solution by Fourier Series. Steady Two-Dimensional Heat Problems. Dirichlet Problem. Heat Equation: Modeling Very Long Bars. Solution by Fourier Integrals and Transforms. Modeling: Membrane, Two-Dimensional Wave Equation. Rectangular Membrane. Laplacian in Polar Coordinates. Circular Membrane. Laplace's Equation in Cylindrical and Spherical Coordinates. Potential. Solution of PDEs by Laplace Transforms. [10Hrs]

Textbooks:
1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10^{th} Ed., 2011.

References:
1. *Engineering Mathematics* by K.A. Stroud withDexter J. Booth, Macmillan, 2020.
2. *Advanced Engineering Mathematics* by Larry Turyn, Taylor and Francis, 2014.
3. *Advanced Engineering Mathematics* by Dennis G. Zill, Jones & Bartlett Learning, 2018.
4. *Advanced Engineering Mathematics with MATLAB* by Dean G. Duffy, Taylor and Francis, 2017.
5. *Advanced Engineering Mathematics* by Merle C. Potter, Jack L. Lessing, and Edward F. Aboufadel, Springer (Switzerland), 2019.
6. *Mathematical Methods for Physics and Engineering*, by K. F. Riley, M. P. Hobson and S. J. Bence, CUP, 2013.

PaperCode: ES-114	Paper: Engineering Mechanics	L	T/P	C
		3	-	3

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart knowledge to solve problems pertaining to force systems, equilibrium and distributed systems.
2:	To impart knowledge to solve problems of friction and engineering trusses.
3:	To impart knowledge to deal with the problems of kinematics and kinetics of particle
4:	To impart knowledge to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO):

CO1	Ability to solve problems pertaining to force systems, equilibrium and distributed systems.
CO2	Ability to solve problems of friction and engineering trusses.
CO3	Ability to deal with the problems of kinematics and kinetics of particle
CO4	Ability to deal with the problems of kinematics and kinetics of rigid bodies.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	1	1	2
CO2	3	3	3	3	2	-	-	-	1	1	1	2
CO3	3	3	3	3	2	-	-	-	1	1	1	2
CO4	3	3	3	3	2	-	-	-	1	1	1	2

Unit I

Force System: Introduction, force, principle of transmissibility of force, resultant of a force system, resolution of a force, moment of force about a line, Varigon's theorem, couple, resolution of force into force and a couple, properties of couple and their application to engineering problems.
Equilibrium: Force body diagram, equations of equilibrium and their applications to engineering problems, equilibrium of two force and three force members.
Distributed Forces: Determination of center of gravity, center of mass and centroid by direct integration and by the method of composite bodies, mass moment of inertia and area moment of inertia by direct integration and composite bodies method, radius of gyration, parallel axis theorem, polar moment of inertial. [10Hrs]

Unit II

Structure: Plane truss, perfect and imperfect truss, assumption in the truss analysis, analysis of perfect plane trusses by the method of joints, method of section and graphical method.

Friction: Static and Kinetic friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, frictional lock, friction in flat pivot and collar bearing, friction in flat belts. [10Hrs]

Unit III

Kinematics of Particles: Rectilinear motion, plane curvilinear motion, rectangular coordinates, normal and tangential coordinates.
Kinetics of Particles: Equation of motion, rectilinear motion and curvilinear motion, work-energy equation, conservation of energy, concept of impulse and momentum, conservation of momentum, impact of bodies, co-efficient of restitution, loss of energy during impact. [10Hrs]

Unit IV

Kinematics of Rigid Bodies: Concept of rigid body, types of rigid body motion, absolute motion, introduction to relative velocity, relative acceleration (Corioli's component excluded) and instantaneous center of zero velocity, Velocity and acceleration.
Kinetics of Rigid Bodies: Equation of motion, translatory motion and fixed axis rotation, application of work energy principles to rigid bodies conservation of energy.
Beam: Introduction, types of loading, methods for the reactions of a beam, space diagram, types of end supports, beams subjected to couple. [10Hrs]

Textbooks:
1.*Engineering Mechanics* by A.K.Tayal, Umesh Publications.

References:
1. '*Engineering Mechanics*' by K. L. Kumar, Tata Mc-Graw Hill
2. '*Engineering Mechanics*' by S. Timoshenko, D. H. Young, J. V. Rao, Tata Mc-Graw Hill
3. '*Engineering Mechanics-Statics and Dynamics*' by Irwing H. Shames, PHI.
4. '*Engineering Mechanics*' by Basudev Bhattacharya, Oxford University Press.

PaperCode: BS-152	Paper: Applied Physics - II Lab.	L	P	C
		-	2	1
Marking Scheme: **1.** Teachers Continuous Evaluation: 40 marks **2.** Term end Theory Examinations: 60 marks				
Instructions: **1.** The course objectives and course outcomes are identical to that of (Applied Physics - I) as this is the practical component of the corresponding theory paper. **2.** The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institiution in which the paper is being offered from the list of practicals below. Atleast 8 experiments must be performed by the students				

1. To determine the e/m ratio of an electron by J.J. Thomson method.
2. To measure the frequency of a sine-wave voltage obtained from signal generator and to obtain lissajous pattern on the CRO screen by feeding two sine wave signals from two signal generators.
3. To determine the frequency of A.C. mains by using Sonometer.
4. To determine the frequency of electrically maintained tuning fork by Melde's method.
5. Computer simulation (simple application of Monte Carlo): Brownian motion, charging & discharging of a capacitor.
6. To study the charging and discharging of a capacitor and to find out the time constant.
7. To study the Hall effect.
8. To verify Stefan's law.
9. To determine the energy band gap of a semiconductor by four probe method/or by measuring the variation of reverse saturation current with temperature.
10. To study the I-V characteristics of Zener diode.
11. To find the thermal conductivity of a poor conductor by Lee's disk method.
12. To study the thermo emf using thermocouple and resistance using Pt. Resistance thermometer.

Note: Teacher's may use the prescribed books to choose the practicals in addition to above. Total 8 practicals minimum shall be performed by the students, they may be asked to do more. Atleast 4 experiments must be from the above list.

Textbook:

1. *B.Sc. Practical Physics* by C. L. Arora, S.Chand & Co., 2020.
2. *Practical physics* by R. K. Shukla and A. Srivastava, New Age Int. (P) Ltd., 2006.

PaperCode: ES-158	Paper: Engineering Graphics-II	L	P	C
		-	2	1

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Course Objectives:

1:	The students will learn sectioning of solid figures.
2:	The students will understand 3D projections. They will have understanding of isometric and oblique projections.
3:	The students will have understanding of perspective projections,
4:	The students will learn computer aided drafting.

Course Outcomes (CO):

CO1	Ability to draw sectional diagrams of solids
CO2	Ability to draw 3S projections (isometric and oblique).
CO3	Ability to draw perspective projections.
CO4	Understand and use a CAD tool (AutoCAD).

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	3	3	3	3	2	-	-	-	1	2	1	2
CO2	3	3	3	3	2	-	-	-	1	2	1	2
CO3	3	3	3	3	2	-	-	-	1	2	1	2
CO4	3	3	3	3	2	-	-	-	1	2	1	2

Unit I
Section of Solids: Definition of Sectioning and its purpose, Procedure of Sectioning, Illustration through examples, Types of sectional planes-application to few examples.

Unit II
Isometric Projection: Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and drawing, Isometric projection of solids such as cube, prism, pyramid and cylinder.
Oblique Projection: Principle of oblique projection, difference between oblique projection and isometric projection, receding lines and receding angles, oblique drawing of circle, cylinder, prism and pyramid.

Unit III
Perspective Projection: Principle of perspective projection, definitions of perspective elements, visual ray method, vanishing point method.
Conversion of 3D to 2D figures.

Unit IV
Introduction to CADD: Interfacing and Introduction to CAD Software, Coordinate System, 2D drafting: lines, circles, arc, polygon, etc., Dimensioning, 2-D Modelling, Use of CAD Software for engineering drawing practices.

Note: The sheets to be created shall be notified by the concerned teacher.

Textbooks:
1. *Engineering Drawing* by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat,2017.

References:
1. *Engineering Drawing* by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.
2. *Technical Drawing with Engineering Graphics* by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016
3. *Engineering Drawing* by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.
4. *AutoCAD 2017 for Engineers & Designers* by Sham Tickoo,, Dreamtech Press 2016.

PaperCode: ES-164	Paper: Workshop Technology	L	P	C
		-	4	2

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the school in which the paper is being offered.

Course Objectives:

1:	The students will learn basics of safety precautions to be taken in lab. / workshop
2:	The students will have an overview of different machines used in workshop and the operations performed on these machines.
3:	The students will have understanding of various welding processes.
4:	The students will have understanding of sheet metals hop and fitting shop

Course Outcomes (CO):

CO1	Ability to safely work in a Lab./workshop.
CO2	Ability to use machines (lathe, mill, shaper, planer, grinder, drill).
CO3	Ability to weld.
CO4	Ability to use sheet metal tools and fitting shop tools.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	2	1	2	2	3	3	-	-	-	-	-	2
CO2	2	1	2	2	3	1	-	-	-	-	-	2
CO3	2	1	2	2	3	1	-	-	-	-	-	2
CO4	2	1	2	2	3	1	-	-	-	-	-	2

Unit I

Safety, precautions and maintenance: Safety in shop, safety devices, safety and precautions - moving machine and equipment parts, electrical parts and connections, fire, various driving systems like chain, belt and ropes, electrical accidents, an overview of predictive, preventive and scheduled maintenance, standard guidelines to be followed in shop.

Unit II

Introduction to machine shop: Introduction to Lathe, Milling, shaper, Planer, grinder, drilling and overview of operations performed on these machines by making some jobs.

Unit III

Introduction to welding shop: Welding, types of welding, tools and applications, gas welding and arc welding, edge preparation, various joints formation by gas welding and electric arc welding.

Unit IV

Introduction to sheet metal shop: Sheet metal tools and operations, formation of a box using sheet. Introduction to fitting shop: Introduction to fitting, tools and applications, some jobs in fitting shop.

Textbooks:

1. *Workshop Technology Vol. 1 and Vol. 2*, Hajra Choudhary and Roy, Media Promoters and Publishers, 2018.

References:

1. *A course in Workshop Technology Vol.1 and Vol. 2*, B. S. Raghuvanshi, Dhanpat Rai and Compnay, 2015.
2. *Workshop Technology (Manufacturing Processes)*, Khurmi and Gupta, S. Chand Publication, 2010.

2nd Year Onward Scheme and implementation guideline for Core Branches (Major / Primary Disciplines), namely:

1. Computer Science and Engineering (CSE)
2. Information Technology (IT)
3. Computer Science and Technology (CST)
4. Information Technology and Engineering (ITE)
5. Electronics and Communications Engineering (ECE)
6. Electrical Engineering (EE)
7. Electrical and Electronics Engineering (EEE)
8. Mechanical Engineering (ME)
9. Instrumentation and Control Engineering (ICE)
10. Civil Engineering (CE)

Bachelor of Technology in Computer Science and Engineering (CSE)

2^{nd} Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:**Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

  i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
  iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

  i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
  ii. Practical File - 10 Marks
  iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-312	Engineering Optimization	4		4
6	CIE-320	Principles of Programming Languages	4		4
6	CIE-322T	Simulation and Modelling	3		3
	CIE-322P	Simulation and Modelling Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-338T	Graph Theory for Computer Science	3		3
	CIE-338P	Graph Theory for Computer Science Lab		2	1
6	CIE-348T	Software Project Management	3		3
	CIE-348P	Software Project Management Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-368T	Mobile Computing	3		3
	CIE-368P	Mobile Computing Lab		2	1
6	CIE-370T	Parallel Computing	3		3
	CIE-370P	Parallel Computing Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-413T	Next Generation Web	3		3
	CIE-413P	Next Generation Web Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-425T	Data Warehousing and Data Mining	3		3
	CIE-425P	Data Warehousing and Data Mining Lab		2	1
7	CIE-431T	Web Mining	3		3
	CIE-431P	Web Mining Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters)for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15^{th} July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1or Table 2 (as applicable)**and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.
17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**
18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).
19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).
20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. The medium of instructions shall be English.

Bachelor of Technology in Information Technology (IT)
2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   - iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Practical File - 10 Marks
   - iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-314	Advanced Computer Architecture	4		4
6	CIE-316	Database Modelling and Design	4		4
6	CIE-328T	Analog and Digital Communications	3		3
	CIE-328P	Analog and Digital Communications Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-336	E-Commerce and M-Commerce	4		4
6	CIE-344T	Object Oriented Analysis and Design using UML	3		3
	CIE-344P	Object Oriented Analysis and Design using UML Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-360T	Introduction to Information and Communication Theory	3		3
	CIE-360P	Introduction to Information and Communication Theory Lab		2	1
6	CIE-366T	Middleware Technologies	3		3
	CIE-366P	Middleware Technologies Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-415T	Wireless Communication and Networks	3		3
	CIE-415P	Wireless Communication and Networks Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-427	Introduction to Mobile Ad Hoc Networks	4		4
7	CIE-431T	Web Mining	3		3
	CIE-431P	Web Mining Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15^{th} July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Information Technology".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. The medium of instructions shall be English.

Bachelor of Technology in Computer Science and Technology (CST)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-310T	Advanced DBMS	3		3
	CIE-310P	Advanced DBMS		2	1
6	CIE-312	Engineering Optimization	4		4
6	CIE-324	Software Testing	4		4
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-340	IT Project Management	4		4
6	CIE-346T	Service Oriented Architecture	3		3
	CIE-346P	Service Oriented Architecture Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-358T	Human Computer Interface	3		3
	CIE-358P	Human Computer Interface Lab		2	1
6	CIE-372T	Software Requirements and Estimation	3		3
	CIE-372P	Software Requirements and Estimation Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-411T	Computer Graphics and Multimedia Technologies	3		3
	CIE-411P	Computer Graphics and Multimedia Technologies Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-423T	Data Visualization	3		3
	CIE-423P	Data Visualization Lab		2	1
7	CIE-425T	Data Warehousing and Data Mining	3		3
	CIE-425P	Data Warehousing and Data Mining Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Technology with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Technology with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Technology";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Technology (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Technology".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.
17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**
18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).
19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).
20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. The medium of instructions shall be English.

Bachelor of Technology in Information Technology and Engineering (ITE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   - iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Practical File - 10 Marks
   - iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	CIE-306T	Advanced Java Programming	3		3
	CIE-306P	Advanced Java Programming Lab		2	1
6	CIE-308T	Visual Basic.NET Programming	3		3
	CIE-308P	Visual Basic.NET Programming Lab		2	1
6	CIE-310T	Advanced DBMS	3		3
	CIE-310P	Advanced DBMS Lab		2	1
6	CIE-318T	Network Security and Cryptography	3		3
	CIE-318P	Network Security and Cryptography Lab		2	1
6	CIE-326T	VHDL Programming	3		3
	CIE-326P	VHDL Programming Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-330T	Introduction to Internet of Things	3		3
	CIE-330P	Introduction to Internet of Things Lab		2	1
6	CIE-332T	Programming in Python	3		3
	CIE-332P	Programming in Python Lab		2	1
6	CIE-334	Quantum Computing	4		4
6	CIE-342T	Multimedia Technologies	3		3
	CIE-342P	Multimedia Technologies Lab		2	1
6	CIE-350	Windows System Administration	4		4
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CIE-354T	Introduction to Digital Signal Processing	3		3
	CIE-354P	Introduction to Digital Signal Processing Lab		2	1
6	CIE-356T	Web Technologies	3		3
	CIE-356P	Web Technologies Lab		2	1
6	CIE-362T	Linux System Administration	3		3
	CIE-362P	Linux System Administration Lab		2	1
6	CIE-364T	Microprocessors and Interfacing	3		3
	CIE-364P	Microprocessors and Interfacing Lab		2	1
6	CIE-374T	Artificial Intelligence	3		3
	CIE-374P	Artificial Intelligence Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-403T	Blockchain Technology	3		3
	CIE-403P	Blockchain Technology Lab		2	1
7	CIE-405T	Data Science	3		3
	CIE-405P	Data Science Lab		2	1
7	CIE-407T	Distributed Systems and Cloud Computing	3		3
	CIE-407P	Distributed Systems and Cloud Computing Lab		2	1
7	CIE-409T	Social Network Analysis and Sentiment Analysis	3		3
	CIE-409P	Social Network Analysis and Sentiment Analysis Lab		2	1
7	CIE-411T	Computer Graphics and Multimedia Technologies	3		3
	CIE-411P	Computer Graphics and Multimedia Technologies Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CIE-417T	C#.NET Programming	3		3
	CIE-417P	C#.NET Programming Lab		2	1
7	CIE-419	Intellectual Property Rights	4		4
7	CIE-421T	Machine Learning	3		3
	CIE-421P	Machine Learning Lab		2	1
7	CIE-423T	Data Visualization	3		3
	CIE-423P	Data Visualization Lab		2	1
7	CIE-429T	Web Intelligence and Big Data Analytics	3		3
	CIE-429P	Web Intelligence and Big Data Analytics Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology and Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology and Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Information Technology and Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Information Technology and Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Information Technology and Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.
17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**
18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).
19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Electronics and Communications Engineering (ECE)

2^{nd} Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ECC-205	Signals and Systems	3		3
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	ECC-209	Analog Communications	4		4
PC	ECC-211	Analog Electronics-I	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	ECC-255	Analog Communications Lab		2	1
PC	ECC-257	Analog Electronics-I Lab		2	1
PC	ECC-259	Signals and Systems Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	EEC-206	Network Analysis and Synthesis	3		3
PC	ECC-210	Microprocessors and Microcontrollers	3		3
PC	ECC-212	Digital Communications	3		3
PC	ECC-214	Analog Electronics-II	3		3
PC	ECC-216	Electromagnetic Field Theory	3		3
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	ECC-256	Microprocessors and Microcontrollers Lab		2	1
PC	ECC-258	Digital Communications Lab		2	1
PC	ECC-260	Analog Electronics-II Lab		2	1
PC	EEC-262	Network Analysis and Synthesis Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	ECC-303	Digital Signal Processing	4		4
PC	ECC-305	Microelectronics	3		3
PC	EEC-307	Introduction to Control Systems	3		3
PC	ECC-309	Transmission Lines, Waveguides and Antenna Design	4		4
PC	ECC-311	Data Communication and Networking	4		4
Practical / Viva Voce					
PC	ECC-351	Digital Signal Processing Lab		2	1
PC	ECC-353	Microelectronics Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	ECC-357	Transmission Lines, Waveguides and Antenna Design Lab		2	1
PC	ECC-359	Data Communication and Networking Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	ECE-306T	VHDL Programming	3		3
	ECE-306P	VHDL Programming Lab		2	1
6	ECE-308T	Digital Image Processing	3		3
	ECE-308P	Digital Image Processing Lab		2	1
6	ECE-310	Mobile Communication	4		4
6	ECE-312T	Advanced Microprocessors and Microcontroller	3		3
	ECE-312P	Advanced Microprocessors and Microcontroller Lab		2	1
6	ECE-314T	RF and Microwave Engineering	3		3
	ECE-314P	RF and Microwave Engineering Lab		2	1
6	ECE-316T	Mobile Computing	3		3
	ECE-316P	Mobile Computing Lab		2	1
6	ECE-318T	Artificial Intelligence	3		3
	ECE-318P	Artificial Intelligence Lab		2	1
6	ECE-320T	Electronic Measurements	3		3
	ECE-320P	Electronic Measurements Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	ECE-322T	Fabrication Technology	3		3
	ECE-322P	Fabrication Technology Lab		2	1
6	ECE-324	Multimedia Communication	4		4
6	ECE-326T	Optical Communication Systems and Networks	3		3
	ECE-326P	Optical Communication Systems and Networks Lab		2	1
6	ECE-328	Advanced Computer Architecture	4		4
6	ECE-330T	Antenna Design and Radiating Systems	3		3
	ECE-330P	Antenna Design and Radiating Systems Lab		2	1
6	ECE-332	Introduction to Information and Coding Theory	4		4
6	ECE-334T	Random Processes and Stochastic Systems	3		3
	ECE-334P	Random Processes and Stochastic Systems Lab		2	1
6	ECE-336T	Radio and Television Engineering	3		3
	ECE-336P	Radio and Television Engineering Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	ECE-338T	CMOS Analog Integrated Circuit Design	3		3
	ECE-338P	CMOS Analog Integrated Circuit Design Lab		2	1
6	ECE-340T	Wavelets	3		3
	ECE-340P	Wavelets Lab		2	1
6	ECE-342T	Wireless Sensor Networks	3		3
	ECE-342P	Wireless Sensor Networks Lab		2	1
6	ECE-344T	Embedded System Architecture and Design	3		3
	ECE-344P	Embedded System Architecture and Design Lab		2	1
6	ECE-346	Solid State Microwave Device and their application	4		4
6	ECE-348	Radar and Satellite Communications	4		4
6	ECE-350T	Machine Learning	3		3
	ECE-350P	Machine Learning Lab		2	1
6	ECE-354T	Introduction to Power Electronics	3		3
	ECE-354P	Introduction to Power Electronics Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	ECE-403T	RF Components and Circuit Design	3		3
	ECE-403P	RF Components and Circuit Design Lab		2	1
7	ECE-405T	Pattern Recognition	3		3
	ECE-405P	Pattern Recognition Lab		2	1

7	ECE-407	Next Generation Networks	4		4
7	ECE-409T	Micro-electromechanical Systems (MEMS) and Sensors	3		3
	ECE-409P	Micro-electromechanical Systems (MEMS) and Sensors Lab		2	1
7	ECE-411T	Fuzzy Logic and Neural Networks	3		3
	ECE-411P	Fuzzy Logic and Neural Networks Lab		2	1
7	ECE-413T	Ad hoc and Sensor Networks	3		3
	ECE-413P	Ad hoc and Sensor Networks Lab		2	1
7	ECE-415	Engineering Optimization	4		4
7	ECE-417T	Optoelectronics Devices	3		3
	ECE-417P	Optoelectronics Devices Lab		2	1
7	ECE-435T	Logic Design and Analysis using Verilog	3		3
	ECE-435T	Logic Design and Analysis using Verilog Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	ECE-419T	Low Power VLSI Design	3		3
	ECE-419P	Low Power VLSI Design Lab		2	1
7	ECE-421T	Medical Image Processing, Analysis and Reconstruction	3		3
	ECE-421P	Medical Image Processing, Analysis and Reconstruction Lab		2	1
7	ECE-423T	Network Security and Cryptography	3		3
	ECE-423P	Network Security and Cryptography Lab		2	1
7	ECE-425	Real Time Operating Systems	4		4
7	ECE-427T	Smart Antennas	3		3
	ECE-427P	Smart Antennas Lab		2	1
7	ECE-429T	Introduction to Internet of Things	3		3
	ECE-429P	Introduction to Internet of Things Lab		2	1
7	ECE-431T	Nature Inspired Biological Optimization Techniques	3		3
	ECE-431P	Nature Inspired Biological Optimization Techniques Lab		2	1
7	ECE-433	Introduction to Robotics Engineering	4		4

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electronics and Communications Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electronics and Communications Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electronics and Communications Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electronics and Communications Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Electronics and Communications Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Electrical Engineering (EE)
2^{nd} Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ECC-205	Signals and Systems	3		3
PC	EEC-209	Electrical Materials	3		3
PC	EEC-211	Electrical Machines - I	4		4
PC	ECC-213	Electromagnetic Field Theory	3		3
PC	ECC-215	Electronics – I	3		3
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	EEC-257	Electrical Machines – I Lab		2	1
PC	EEC-259	Electrical Engineering Workshop		2	1
PC	ECC-261	Electronics - I Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	EEC-206	Network Analysis and Synthesis	3		3
PC	EEC-210	Electrical Machines - II	4		4
PC	EEC-212	Power Systems - I	4		4
PC	ECC-218	Electronics - II	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-256	Electrical Machines - II Lab		2	1
PC	EEC-260	Power Systems - I Lab		2	1
PC	EEC-262	Network Analysis and Synthesis Lab		2	1
PC	ECC-264	Electronics - II Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	EEC-303	Power Systems – II	4		4
PC	EEC-305	Electrical and Electronics Measuring Instruments	4		4
PC	EEC-307	Introduction to Control Systems	3		3
PC	EEC-309	Power Electronics	4		4
PC	ECC-313	Microprocessors and Microcontrollers	3		3
Practical / Viva Voce					
PC	EEC-351	Power Systems – II Lab		2	1
PC	EEC-353	Electrical and Electronics Measurements Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	EEC-357	Power Electronics Lab		2	1
PC	ECC-363	Microprocessors and Microcontrollers Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	EEE-308	Artificial Intelligence and Machine Learning for Electrical Systems	4		4
6	EEE-310T	Bio Medical Instrumentation	3		3
	EEE-310P	Bio Medical Instrumentation Lab		2	1
6	EEE-312T	Introduction to Digital Signal Processing	3		3
	EEE-312P	Introduction to Digital Signal Processing Lab		2	1
6	EEE-318	Stochastic Processes and Systems	4		4
6	EEE-320T	Utilization of Electrical Energy	3		3
	EEE-320P	Utilization of Electrical Energy Lab		2	1
6	EEE-358	Electrical Power Generation Systems	4		4
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-322T	Computer Aided Electrical Machine Design	3		3
	EEE-322P	Computer Aided Electrical Machine Design Lab		2	1
6	EEE-324T	Introduction to Data Communication and Networking	3		3
	EEE-324P	Introduction to Data Communication and Networking Lab		2	1
6	EEE-326T	Discrete Control Systems	3		3
	EEE-326P	Discrete Control Systems Lab		2	1
6	EEE-334T	Research Methodology for Electrical & Electronics Engineering	3		3
	EEE-334P	Research Methodology for Electrical & Electronics Engineering Lab		2	1
6	EEE-336T	Introduction to Transmission Lines, Waveguides and Antenna Design	3		3
	EEE-336P	Introduction to Transmission Lines, Waveguides and Antenna Design Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-340T	Electric Drives	3		3
	EEE-340P	Electric Drives Lab		2	1
6	EEE-356T	Optimization using Controllers	3		3
	EEE-356P	Optimization using Controllers lab		2	1
6	EEE-360	Process Control	4		4
6	EEE-362T	VLSI	3		3
	EEE-362P	VLSI Lab		2	1
6	EEE-364T	Systems Design and Simulation	3		3
	EEE-364P	Systems Design and Simulation Lab		2	1
6	EEE-366	Introduction to Information and Coding Theory	4		4
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-403	Electricity Distribution Schemes and Policies	4		4
7	EEE-405T	Mathematical Analysis of Complex Systems	3		3
	EEE-405P	Mathematical Analysis of Complex Systems Lab		2	1
7	EEE-407	Renewable Energy and Policies	4		4
7	EEE-409T	Solid State Drives	3		3
	EEE-409P	Solid State Drives Lab		2	1
7	EEE-411T	Switchgear and Protection	3		3
	EEE-411P	Switchgear and Protection Lab		2	1
7	EEE-413T	Digital Image Processing	3		3
	EEE-413P	Digital Image Processing Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-421T	e-Mobility	3		3
	EEE-421P	e-Mobility Lab		2	1
7	EEE-423	Energy Conservation Schemes	4		4
7	EEE-425	Energy Economics and Policies	4		4
7	EEE-427	High Voltage Engineering	4		4

7	EEE-429T	Mathematical Model for Reliability of Transmission and Distribution	3		3
	EEE-429P	Mathematical Model for Reliability of Transmission and Distribution Lab		2	1
7	EEE-431	Smart Grid and Distributed Generation	4		4
7	EEE-433T	Systems Restructuring for Optimization	3		3
	EEE-433P	Systems Restructuring for Optimization Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Electrical Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. The medium of instructions shall be English.

Bachelor of Technology in Electrical and Electronics Engineering (EEE)

2^{nd} Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ECC-205	Signals and Systems	3		3
PC	EEC-209	Electrical Materials	3		3
PC	EEC-211	Electrical Machines - I	4		4
PC	ECC-213	Electromagnetic Field Theory	3		3
PC	ECC-215	Electronics – I	3		3
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	EEC-257	Electrical Machines – I Lab		2	1
PC	EEC-259	Electrical Engineering Workshop		2	1
PC	ECC-261	Electronics - I Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	EEC-206	Network Analysis and Synthesis	3		3
PC	EEC-210	Electrical Machines - II	4		4
PC	EEC-212	Power Systems - I	4		4
PC	ECC-218	Electronics - II	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-256	Electrical Machines - II Lab		2	1
PC	EEC-260	Power Systems - I Lab		2	1
PC	EEC-262	Network Analysis and Synthesis Lab		2	1
PC	ECC-264	Electronics - II Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	EEC-303	Power Systems – II	4		4
PC	EEC-305	Electrical and Electronics Measuring Instruments	4		4
PC	EEC-307	Introduction to Control Systems	3		3
PC	EEC-309	Power Electronics	4		4
PC	ECC-313	Microprocessors and Microcontrollers	3		3
Practical / Viva Voce					
PC	EEC-351	Power Systems – IILab		2	1
PC	EEC-353	Electrical and Electronics Measurements Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	EEC-357	Power Electronics Lab		2	1
PC	ECC-363	Microprocessors and Microcontrollers Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****<u>NUES</u>:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:** Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

***** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	EEE-306T	Analog and Digital Communications	3		3
	EEE-306P	Analog and Digital Communications Lab		2	1
6	EEE-308	Artificial Intelligence and Machine Learning for Electrical Systems	4		4
6	EEE-310T	Bio Medical Instrumentation	3		3
	EEE-310P	Bio Medical Instrumentation Lab		2	1
6	EEE-312T	Introduction to Digital Signal Processing	3		3
	EEE-312P	Introduction to Digital Signal Processing Lab		2	1
6	EEE-314	Powerline Carrier Communication	4		4
6	EEE-320T	Utilization of Electrical Energy	3		3
	EEE-320P	Utilization of Electrical Energy Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-324T	Introduction to Data Communication and Networking	3		3
	EEE-324P	Introduction to Data Communication and Networking Lab		2	1
6	EEE-326T	Discrete Control Systems	3		3
	EEE-326P	Discrete Control Systems Lab		2	1
6	EEE-330	Nano Electronics	4		4
6	EEE-332	Opto Electronics	4		4
6	EEE-334T	Research Methodology for Electrical & Electronics Engineering	3		3
	EEE-334P	Research Methodology for Electrical & Electronics Engineering Lab		2	1
6	EEE-336T	Introduction to Transmission Lines, Waveguides and Antenna Design	3		3
	EEE-336P	Introduction to Transmission Lines, Waveguides and Antenna Design Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	EEE-338T	Digital Systems Design	3		3
	EEE-338P	Digital Systems Design Lab		2	1
6	EEE-340T	Electric Drives	3		3
	EEE-340P	Electric Drives Lab		2	1
6	EEE-354	Electrical Power Generation Systems	4		4
6	EEE-356T	Optimization using Controllers	3		3
	EEE-356P	Optimization using Controllers lab		2	1
6	EEE-362T	VLSI	3		3
	EEE-362P	VLSI Lab		2	1
6	EEE-366	Introduction to Information and Coding Theory	4		4
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-403	Electricity Distribution Schemes and Policies	4		4
7	EEE-405T	Mathematical Analysis of Complex Systems	3		3
	EEE-405P	Mathematical Analysis of Complex Systems Lab		2	1
7	EEE-407	Renewable Energy and Policies	4		4
7	EEE-409T	Solid State Drives	3		3
	EEE-409P	Solid State Drives Lab		2	1
7	EEE-413T	Digital Image Processing	3		3
	EEE-413P	Digital Image Processing Lab		2	1
7	EEE-415T	Wireless Sensor Networks	3		3
	EEE-415P	Wireless Sensor Networks Lab		2	1
7	EEE-435T	Systems Design and Simulation	3		3
	EEE-435P	Systems Design and Simulation Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	EEE-417T	Advanced Semiconductor Devices	3		3
	EEE-417P	Advanced Semiconductor Devices Lab		2	1

7	EEE-419T	Communication Systems Analysis	3		3
	EEE-419P	Communication Systems Analysis Lab		2	1
7	EEE-421T	e-Mobility	3		3
	EEE-421P	e-Mobility Lab		2	1
7	EEE-423	Energy Conservation Schemes	4		4
7	EEE-425	Energy Economics and Policies	4		4
7	EEE-431	Smart Grid and Distributed Generation	4		4
7	EEE-433T	Systems Restructuring for Optimization	3		3
	EEE-433P	Systems Restructuring for Optimization Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15^{th} July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an

Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Electrical and Electronics Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Electrical and Electronics Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.
17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**
18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).
19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Instrumentation and Control Engineering (ICE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	ICC-205	Engineering Electromagnetics	4		4
PC	EEC-207	Electrical Machines	4		4
PC	EEC-213	Circuits and Systems	4		4
PC	ECC-219	Analog Electronics	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	EEC-253	Circuits and Systems Lab		2	1
PC	EEC-255	Electrical Machines Lab		2	1
PC	ECC-265	Analog Electronics Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	ECC-206	Communication Systems	4		4
PC	ECC-208	Digital Electronics	4		4
PC	ICC-210	Sensors and Transducers	4		4
PC	EEC-214	Electrical and Electronics Measurements	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	ECC-254	Digital Electronics Lab		2	1
PC	ICC-256	Sensors and Transducers Lab		2	1
PC	EEC-258	Electrical and Electronics Measurements Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	ECC-303	Digital Signal Processing	4		4
PC	EEC-307	Introduction to Control Systems	3		3
PC	ICC-309	Industrial and Optical Instrumentation	4		4
PC	CIC-313	Computer Networks	4		4
PC	ECC-313	Microprocessors and Microcontrollers	3		3
Practical / Viva Voce					
PC	ECC-351	Digital Signal Processing Lab		2	1
PC	EEC-355	Introduction to Control Systems Lab		2	1
PC	ICC-357	Industrial and Optical Instrumentation Lab		2	1
PC	ECC-363	Microprocessors and Microcontrollers Lab		2	1
PC	CIC-365	Computer Networks Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***<u>NUES</u>:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****<u>NUES</u>:**Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

**The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

***** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	ICE-306T	Process Control	3		3
	ICE-306P	Process Control Lab		2	1
6	ICE-308	Measurement Data Analysis	4		4
6	ICE-310	Control System Components	4		4
6	ICE-312	Energy Harvesting Techniques	4		4
6	ICE-314T	Advanced Control Systems for Instrumentation	3		3
	ICE-314P	Advanced Control Systems for Instrumentation Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	ICE-316T	Embedded Systems	3		3
	ICE-316P	Embedded Systems Lab		2	1
6	ICE-318T	Industrial Automation and Control	3		3
	ICE-318P	Industrial Automation and Control Lab		2	1
6	ICE-320T	Hydraulics and Pneumatics	3		3
	ICE-320P	Hydraulics and Pneumatics Lab		2	1
6	ICE-322T	Neural Networks and Fuzzy Logic	3		3
	ICE-322P	Neural Networks and Fuzzy Logic Lab		2	1
6	ICE-324T	Smart and Wireless Instrumentation	3		3
	ICE-324P	Smart and Wireless Instrumentation Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	ICE-326T	Instrumentation Devices	3		3
	ICE-326P	Instrumentation Devices Lab		2	1
6	ICE-328T	Introduction to Internet of Things	3		3
	ICE-328P	Introduction to Internet of Things Lab		2	1
6	ICE-330T	Logic and Distributed Control	3		3
	ICE-330P	Logic and Distributed Control Lab		2	1
6	ICE-332T	Industrial Data Communication	3		3
	ICE-332P	Industrial Data Communication Lab		2	1
6	ICE-334T	Industrial Electric Drives	3		3
	ICE-334P	Industrial Electric Drives Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	ICE-403T	Virtual Instrumentation	3		3
	ICE-403P	Virtual Instrumentation Lab		2	1
7	ICE-405T	Soft Computing	3		3
	ICE-405P	Soft Computing Lab		2	1
7	ICE-407T	Bio Medical Instrumentation	3		3
	ICE-407P	Bio Medical Instrumentation Lab		2	1
7	ICE-409T	Control System Design	3		3
	ICE-409P	Control System Design Lab		2	1
7	ICE-411T	Power Plant Instrumentation	3		3
	ICE-411P	Power Plant Instrumentation Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	ICE-413T	Instrumentation System Design	3		3
	ICE-413P	Instrumentation System Design Lab		2	1
7	ICE-415T	Design of Sensors and Transducers	3		3
	ICE-415P	Design of Sensors and Transducers Lab		2	1
7	ICE-417T	Advanced Process Control	3		3
	ICE-417P	Advanced Process Control Lab		2	1
7	ICE-419T	Cyber Security for Industrial Automation	3		3
	ICE-419P	Cyber Security for Industrial Automation Lab		2	1
7	ICE-421T	Digital Control System	3		3
	ICE-421P	Digital Control System Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15^{th} July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Instrumentation and Control Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an

Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Instrumentation and Control Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Instrumentation and Control Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Instrumentation and Control Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Instrumentation and Control Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
22. **The medium of instructions shall be English.**

Bachelor of Technology in Mechanical Engineering (ME)
2^{nd} Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	MEC-205	Theory of Machines	4		4
PC	MEC-207	Strength of Materials	4		4
PC	MEC-209	Manufacturing Science and Technology-I	4		4
PC	MEC-211	Thermal Engineering - I	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	MEC-253	Theory of Machines Lab		2	1
PC	MEC-255	Strength of Materials Lab		2	1
PC	MEC-257	Thermal Engineering – I Lab		2	1
PC	MEC-259	Manufacturing Science and Technology-I Lab		2	1
Total			**22**	**10**	**27**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	MEC-206	Manufacturing Science and Technology-II	4		4
PC	MEC-208	Material Science and Metallurgy	4		4
PC	MEC-210	Thermal Engineering - II	4		4
PC	MEC-212	Machine Design-I	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	MEC-254	Manufacturing Science and Technology-II Lab		2	1
PC	MEC-256	Thermal Engineering - II Lab		2	1
PC	MEC-258	Machine Design - I Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	MEC-303	Machine Design-II	3		3
PC	MEC-305	Fluid Mechanics and Hydraullic Machines	4		4
PC	MEC-307	Metrology and Instrumentation	3		3
PC	MEC-309	Industrial Engineering	4		4
PC	MEC-311	Heat and Mass Transfer	4		4
Practical / Viva Voce					
PC	MEC-351	Machine Design-II Lab		2	1
PC	MEC-353	Fluid Mechanics and Hydraullic Machines Lab		2	1
PC	MEC-355	Metrology and Instrumentation Lab		2	1
PC	MEC-357	Heat and Mass Transfer Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**8**	**25**

***NUES:** Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

**The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor which the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   - iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Practical File - 10 Marks
   - iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	MEE-306T	Automobile Engineering and Electric Vehicles	3		3
	MEE-306P	Automobile Engineering and Electric Vehicles Lab		2	1
6	MEE-308T	Turbomachines	3		3
	MEE-308P	Turbomachines Lab		2	1
6	MEE-310T	Finite Element Methods	3		3
	MEE-310P	Finite Element Methods Lab		2	1
6	MEE-312T	IC Engines and Gas Turbines	3		3
	MEE-312P	IC Engines and Gas Turbines Lab		2	1
6	MEE-314T	Gas Dynamics & Jet Propulsion	3		3
	MEE-314P	Gas Dynamics & Jet Propulsion Lab		2	1
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	MEE-316T	Refrigeration and Airconditioning	3		3
	MEE-316P	Refrigeration and Airconditioning Lab		2	1
6	MEE-318T	Power Plant Engineering	3		3
	MEE-318P	Power Plant Engineering Lab		2	1
6	MEE-320T	Mechanical Vibrations	3		3
	MEE-320P	Mechanical Vibrations Lab		2	1
6	MEE-322T	Reliability & Maintenance Engineering	3		3
	MEE-322P	Reliability & Maintenance Engineering Lab		2	1
6	MEE-324T	Advanced Machine Design	3		3
	MEE-324P	Advanced Machine Design Lab		2	1
6	MEE-326T	Introduction to CAD/CAM	3		3
	MEE-326P	Introduction to CAD/CAM Lab		2	1
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	MEE-328T	Robotics Engineering	3		3
	MEE-328P	Robotics Engineering Lab		2	1
6	MEE-330T	Advance Material Science and Metallurgy	3		3
	MEE-330P	Advance Material Science and Metallurgy Lab		2	1
6	MEE-332T	Metal Forming and Press Working	3		3
	MEE-332P	Metal Forming and Press Working Lab		2	1
6	MEE-334T	Advances in Welding & Casting	3		3
	MEE-334P	Advances in Welding & Casting Lab		2	1
6	MEE-336T	System Modeling, simulation and Analysis	3		3
	MEE-336P	System Modeling, Simulation and Analysis Lab		2	1
6	MEE-338T	Elastic & Plastic Behaviour of Materials	3		3
	MEE-338P	Elastic & Plastic Behaviour of Materials Lab		2	1
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	MEE-403T	Geometric Modelling and Analysis	3		3
	MEE-403P	Geometric Modelling and Analysis Lab		2	1
7	MEE-405T	Computer integrated Manufacturing	3		3
	MEE-405P	Computer integrated Manufacturing Lab		2	1
7	MEE-407T	Control Systems and Applications	3		3
	MEE-407P	Control Systems and Applications Lab		2	1
7	MEE-409T	Rapid prototyping Tooling and Manufacturing	3		3
	MEE-409P	Rapid prototyping Tooling and Manufacturing Lab		2	1
7	MEE-411T	Automation in Manufacturing	3		3
	MEE-411P	Automation in Manufacturing Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	MEE-413T	Strength of Materials-II	3		3
	MEE-413P	Strength of Materials-II Lab		2	1

7	MEE-415T	Design of Mechanical Drives	3		3
	MEE-415P	Design of Mechanical Drives Lab		2	1
7	MEE-417T	Design of Experiments	3		3
	MEE-417P	Design of Experiments Lab		2	1
7	MEE-419T	Advance Metal Cutting and Tool Design	3		3
	MEE-419P	Advance Metal Cutting and Tool Design Lab		2	1
7	MEE-421T	Design of Mechanical Assemblies	3		3
	MEE-421P	Design of Mechanical Assemblies Lab		2	1
7	MEE-423T	Non Traditional Manufacturing	3		3
	MEE-423P	Non Traditional Manufacturing Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Mechanical Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Mechanical Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Mechanical Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Mechanical Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Mechanical Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.
17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**
18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).
19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).
20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. The medium of instructions shall be English.

Bachelor of Technology in Civil Engineering (CE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CEC-205	Structural Analysis - I	4		4
PC	CEC-207	Structural Design - I	4		4
PC	CEC-209	Fluid Mechanics	4		4
PC	CEC-211	Geomatics Engineering	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	CEC-253	Civil Engineering Drawing Lab		2	1
PC	CEC-255	Fluid Mechanics Lab		2	1
PC	CEC-257	Geomatics Engineering Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CEC-206	Soil Mechanics	4		4
PC	CEC-208	Hydraulics and Hydrology	4		4
PC	CEC-210	Environmental Engineering - I	4		4
PC	CEC-212	Transportation Engineering	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	CEC-254	Soil Mechanics Lab		2	1
PC	CEC-256	Hydraulics Lab		2	1
PC	CEC-258	Transportation Engineering Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CEC-303	Structural Analysis - II	4		4
PC	CEC-305	Structural Design - II	3		3
PC	CEC-307	Geotechnical Engineering	4		4
PC	CEC-309	Environmental Engineering - II	4		4
PC	CEC-311	Traffic Engineering and Pavement Design	4		4
Practical / Viva Voce					
PC	CEC-351	Structural Design Lab		2	1
PC	CEC-353	Building Material and Concrete Testing Lab		2	1
PC	CEC-355	Geotechnical Engineering Lab		2	1
PC	CEC-357	Environmental Engineering Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**21**	**8**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PCE		Programme Core Elective Paper (PCE –1)			4
PCE		Programme Core Elective Paper (PCE – 2)			4
PCE		Programme Core Elective Paper (PCE – 3)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 1 /OAE – 1)			4
EAE / OAE		Emerging Area/Open Area Elective Paper (EAE – 2 /OAE – 2)			4
Practical / Viva Voce					
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PCE		Programme Core Elective Paper (PCE – 4)			4
PCE		Programme Core Elective Paper (PCE – 5)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 3 / OAE – 3)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 4 / OAE – 4)			4
EAE / OAE		Emerging Area / Open Area Elective Paper (EAE – 5 / OAE – 5)			4
Practical / Viva Voce					
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***<u>NUES</u>:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***<u>NUES</u>: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Programme Core Electives

Semester	Paper Code	PCE – 1 (Choose Any One)	L	P	Credits
6	CEE-306	Advance Structural Analysis	4		4
6	CEE-308	Irrigation Engineering and Design of Hydraulic Structures	4		4
6	CEE-310	Environmental Impact Assessment	4		4
Semester	**Paper Code**	**PCE – 2 (Choose Any One)**	**L**	**P**	**Credits**
6	CEE-312T	Advanced Structural Design	3		3
	CEE-312P	Advanced Structural Design Lab		2	1
6	CEE-314	Water Resource Planning	4		4
6	CEE-316	Pollution Control and Monitoring	4		4
Semester	**Paper Code**	**PCE – 3 (Choose Any One)**	**L**	**P**	**Credits**
6	CEE-318T	Non Destructive Evaluation of Structures	3		3
	CEE-318P	Non Destructive Evaluation of Structures Lab		2	1
6	CEE-320	Open Chanel Flow and Sediment Transportation	4		4
6	CEE-322	Disaster Management	4		4
Semester	**Paper Code**	**PCE – 4 (Choose Any One)**	**L**	**P**	**Credits**
7	CEE-403	Recent Construction Technologies	4		4
7	CEE-405T	Arc GIS and Remote Sensing	3		3
	CEE-405P	Arc GIS and Remote Sensing Lab		2	1
7	CEE-407T	Transport Planning and Intelligent Transportation System	3		3
	CEE-407P	Transport Planning and Intelligent Transportation System Lab		2	1
Semester	**Paper Code**	**PCE – 5 (Choose Any One)**	**L**	**P**	**Credits**
7	CEE-409	Structural Dynamics	4		4
7	CEE-411	Lean Construction Technology and Management	4		4
7	CEE-413T	Advanced Surveying	3		3
	CEE-413P	Advanced Surveying Lab		2	1

Note:

1. An elective shall be offered to the student for each PCE group (That is for PCE-1, PCE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective. At least two elective per PCE group must be offered to the students of the major discipline.

2. Each PCE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of PCE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24		4	20	**86**	**76**
PCE					12	8		**20**	**16**
EAE/OAE					8	12		**20**	**16**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24		4	20	**86**	**76**
PCE				12	8		**20**	**16**
EAE/OAE				8	12		**20**	**16**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 86 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 5 subjects from EAE / OAE groups. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. **If a student takes even one OAE paper through MOOCs, then the student shall not be eligible for minor specialization.** The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.b. or 12.c.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

   Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

   If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

   The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

   The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded one minor specialization, one from EAE/OEA route under the following conditions:

       i. The student has earned the mandatory credits as defined in Table 1 or Table 2 (as applicable) and clause 6.

       ii. The student earns 20 credits from one group of EAE / OAE courses offered as a minor specialization by the institute.

       iii. In addition, the total credits (including the above specified credits) earned by the student is atleast as **specified in clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Civil Engineering with Minor Specializations in <concerned EAE/OAE discipline>***"; if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degree shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Civil Engineering with Minor Specializations in <concerned EAE/OAE discipline>) (Honours)"***, if in addition to **point 12.a.i, 12.a.ii, and 12.a.iii,** the student fulfils the criteria for Honours as specified at **point 9**.

b. The students shall be awarded the degree without any minor specialization under the following conditions:

   i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

   ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

   The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Civil Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Civil Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

c. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Civil Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.

14. ***Pass marks in every paper shall be 40.***

15. ***Grading System shall be as per Ordinance 11 of the University.***

16. The Programme Core Electives (PCE) shall be specific to a major discipline, minor specializations and papers for EAE shall be defined by the school defining the syllabus for the particular areas and minor specializations and papers for OAE shall be defined by the schools defining the elective streams.

17. **Minor specialization in non-engineering disciplines may be offered under the aegis of the other schools (provided the individual institutions are offering programmes under the aegis of the school offering the non-engineering minor specialization). The minor specialization framework of 20 credits has to be offered within the framework of the current Scheme of Studies of the primary / major discipline.**

18. The institution shall offer atleast two elective groups out of the emerging area / open area for students of each major discipline. The emerging area / open electives can also be offered as standalone papers not forming a part of any elective groups also. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (EAE / OAE).

19. The institution shall offer atleast two elective papers from each program core elective group for students of each major / primary discipline. The institute shall decide the individual papers to be offered as electives (PCE) based on the availability of infrastructure and faculty. From the papers offered by the institute, an elective paper shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major / primary discipline for which the paper is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an elective (PCE).

20. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the

Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.

21. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.

22. The medium of instructions shall be English.

MINOR SPECIALIZATION TO BE OFFERED TO CORE ENGINEERING DISCIPLINES ONLY

Emerging Area Elective Groups (for Minor Specialization) – Applicable only for Core Disciplines (EAE)

The minor specialization is offered through a set of five papers that the student has to study to acquire the minor specialization. The number of papers to be studied is two in 6th semester and three in 7th semester. The minor specialization shall be awarded if and only if 20 credits are earned from an individual / specific minor specialization area. From each paper group associated with a paper slot in a particular semester, the student shall be allowed to study only one paper group. The papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Minor specialization is not necessary for award of the degree, the student may choose five papers from the groups offered by the institution to a particular student (belonging to a major discipline) across groups. Minimum two minor specialization groups should be offered by the institution to students of any particular major discipline from either of the open area or emerging area groups

An elective shall be offered to the student for each Minor Specialization group in Emerging Area (That is for EAE-1, EAE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

Each EAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of EAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required. The nomenclature of the paper group is <*ACRONYM OF EMERGING AREA*> - EAE - <SLOT NUMBER>< A or B or C etc., if required>. The major disciplines to which the Emerging Area Elective Group papers can be offered is specified as acronym together with the name of the minor specialization.

In lieu of Emerging Area Elective, students can study papers from Open Area Elective groups also as offered to them.

Emerging Area Specialization: Artificial Intelligence (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	AI-EAE-1	AI-302T	Artificial Intelligence	3		3
		AI-302P	Artificial Intelligence Lab		2	1
6	AI-EAE-2	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
7	AI-EAE-3	SC-401T	Soft Computing	3		3
		SC-401P	Soft Computing Lab		2	1
7	AI-EAE-4	AI-403T	Artificial Intelligence Applications	3		3
		AI-403P	Artificial Intelligence Applications Lab		2	1
7	AI-EAE-5	AI-405T	Intelligent and Expert Systems	3		3
		AI-405P	Intelligent and Expert Systems Lab		2	1

Emerging Area Specialization: Artificial Intelligence and Machine Learning (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	AIML-EAE-1	AI-302T	Artificial Intelligence	3		3
		AI-302P	Artificial Intelligence Lab		2	1
6	AIML-EAE-2	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
7	AIML-EAE-3	ML-407T	Machine Learning	3		3
		ML-407P	Machine Learning Lab		2	1
7	AIML-EAE-4	ML-409T	Reinforcement Learning and Deep Learning	3		3
		ML-409P	Reinforcement Learning and Deep Learning Lab		2	1
7	AIML-EAE-5	ML-411T	Pattern Recognition and Computer Vision	3		3
		ML-411P	Pattern Recognition and Computer Vision Lab		2	1

Emerging Area Specialization: Data Science (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	DS-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	DS-EAE-2	AI-316T	Artificial Intelligence and Machine Learning	3		3
		AI-316P	Artificial Intelligence and Machine Learning Lab		2	1
7	DS-EAE-3	DS-427T	Data Science using R	3		3
		DS-427P	Data Science using R Lab		2	1
7	DS-EAE-4	DS-429T	Big Data Analytics	3		3
		DS-429P	Big Data Analytics Lab		2	1
7	DS-EAE-5A OR	DS-431T	Business Intelligence	3		3
		DS-431P	Business Intelligence Lab		2	1
	DS-EAE-5B	DS-433T	Exploratory Data Analytics and Data Visualization	3		3
		DS-433P	Exploratory Data Analytics and Data Visualization Lab		2	1

Emerging Area Specialization: Block Chain Technology (for CSE / IT / CST / ITE/ECE/EE/EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	BT-EAE-1	CS-306T	Mathematics of Modern Cryptography	3		3
		CS-306P	Mathematics of Modern Cryptography Lab		2	1
6	BT-EAE-2	BT-308T	Blockchain Technology	3		3
		BT-308P	Blockchain Technology Lab		2	1
7	BT-EAE-3	BT-413T	Bitcoin and Cryptocurrency Technologies	3		3
		BT-413P	Bitcoin and Cryptocurrency Technologies Lab		2	1
7	BT-EAE-4	BT-415T	Smart Contracts	3		3
		BT-415P	Smart Contracts Lab		2	1
7	BT-EAE-5A OR	BT-417T	Blockchain for Cyber Security	3		3
		BT-417P	Blockchain for Cyber Security Lab		2	1
	BT-EAE-5B	BT-419T	Blockchain Technology in Web Development	3		3
		BT-419P	Blockchain Technology in Web Development Lab		2	1

Emerging Area Specialization: Internet of Things (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IOT-EAE-1A OR	IOT-324T	Introduction to Internet of Things	3		3
		IOT-324P	Introduction to Internet of Things Lab		2	1
	IOT-EAE-1B	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
6	IOT-EAE-2A OR	ES-328T	Embedded Linux	3		3
		ES-328P	Embedded Linux Lab		2	1
	IOT-EAE-2B OR	IOT-330T	Programming in Python	3		3
		IOT-330P	Programming in Python Lab		2	1
	IOT-EAE-2C	IOT-332T	Wireless Sensor Networks	3		3
		IOT-332P	Wireless Sensor Networks Lab		2	1
7	IOT-EAE-3	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
		IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
7	IOT-EAE-4	IOT-443T	Design of Smart Systems	3		3
		IOT-443P	Design of Smart Systems Lab		2	1
7	IOT-EAE-5A OR	IOT-445T	Internet of Things Industrial and Medical Case Studies	3		3
		IOT-445P	Internet of Things Industrial and Medical Case Studies Lab		2	1
	IOT-EAE-5B OR	IOT-447T	Internet of Things Frameworks	3		3
		IOT-447P	Internet of Things Frameworks Lab		2	1
	IOT-EAE-5C	IOT-449	Privacy and Security issues in IoT	4		4

Emerging Area Specialization: Internet of Things and Cyber Security including Block Chain Technology (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ICB-EAE-1A OR	IOT-324T	Introduction to Internet of Things	3		3
		IOT-324P	Introduction to Internet of Things Lab		2	1
	ICB-EAE-1B	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
6	ICB-EAE-2A OR	ES-328T	Embedded Linux	3		3
		ES-328P	Embedded Linux Lab		2	1
	ICB-EAE-2B OR	IOT-330T	Programming in Python	3		3
		IOT-330P	Programming in Python Lab		2	1
	ICB-EAE-2C	IOT-332T	Wireless Sensor Networks	3		3
		IOT-332P	Wireless Sensor Networks Lab		2	1
7	ICB-EAE-3	CS-423T	Cyber Security and Forensics	3		3
		CS-423P	Cyber Security and Forensics Lab		2	1
7	ICB-EAE-4	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
		IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
7	ICB-EAE-5	BT-443T	Blockchain Technology	3		3
		BT-443P	Blockchain Technology Lab		2	1

Emerging Area Specialization: Networks (for CSE / IT / CST / ITE / ECE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	NET-EAE-1	NET-344T	Advanced Computer Networks and Administration	3		3
		NET-344P	Advanced Computer Networks and Administration Lab		2	1
6	NET-EAE-2	NET-346T	Linux System Administration	3		3
		NET-346P	Linux System Administration Lab		2	1
7	NET-EAE-3	NET-471T	Network Programming	3		3
		NET-471P	Network Programming Lab		2	1
7	NET-EAE-4	NET-473T	Cloud Computing and Security	3		3
		NET-473P	Cloud Computing and Security Lab		2	1
7	NET-EAE-5	NET-475T	Wireless Sensor Networks	3		3
		NET-475P	Wireless Sensor Networks Lab		2	1

Emerging Area Specialization: Cyber Security (for CSE / IT / CST / ITE / ECE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CS-EAE-1	CS-310T	Information Theory and Coding	3		3
		CS-310P	Information Theory and Coding Lab		2	1
6	CS-EAE-2A OR	CS-312T	Network Security and Cryptography	3		3
		CS-312P	Network Security and Cryptography Lab		2	1
	CS-EAE-2B	CS-314T	Network Security Issues and Challenges	3		3
		CS-314P	Network Security Issues and Challenges Lab		2	1
7	CS-EAE-3	CS-421T	Cyber Crime and Cyber Laws	3		3
		CS-421P	Cyber Crime and Cyber Laws Lab		2	1
7	CS-EAE-4	CS-423T	Cyber Security and Forensics	3		3
		CS-423P	Cyber Security and Forensics Lab		2	1
7	CS-EAE-5	CS-425T	Ethical Hacking	3		3
		CS-425P	Ethical Hacking Lab		2	1

Emerging Area Specialization: Soft Computing (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SC-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	SC-EAE-2	ML-348T	Artificial Neural Networks and Deep Learning	3		3
		ML-348P	Artificial Neural Networks and Deep Learning Lab		2	1
7	SC-EAE-3	SC-477T	Fuzzy Systems and Applications	3		3
		SC-477P	Fuzzy Systems and Applications Lab		2	1
7	SC-EAE-4	SC-479T	Global Optimization Methods	3		3
		SC-479P	Global Optimization Methods Lab		2	1
7	SC-EAE-5	SC-481T	Soft Computing and Expert Systems	3		3
		SC-481P	Soft Computing and Expert Systems Lab		2	1

Emerging Area Specialization: Machine Learning & Data Analytics (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	MLDA-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	MLDA-EAE-2A OR	DA-338T	Data Analytics	3		3
		DA-338P	Data Analytics Lab		2	1
	MLDA-EAE-2B OR	DS-340T	Data Visualization	3		3
		DS-340P	Data Visualization Lab		2	1
	MLDA-EAE-2C	ML-342T	Machine Learning	3		3
		ML-342P	Machine Learning Lab		2	1
7	MLDA-EAE-3	ML-463T	Supervised and Deep Learning	3		3
		ML-463P	Supervised and Deep Learning Lab		2	1
7	MLDA-EAE-4	ML-465T	Unsupervised Learning	3		3
		ML-465P	Unsupervised Learning Lab		2	1
7	MLDA-EAE-5A OR	ML-467T	Machine Learning and Data Analytics Case Studies	3		3
		ML-467P	Machine Learning and Data Analytics Case Studies Lab		2	1
	MLDA-EAE-5B	ML-469T	Machine Learning and Data Analytics Frameworks	3		3
		ML-469P	Machine Learning and Data Analytics Frameworks Lab		2	1

Emerging Area Specialization: Software Engineering (for CSE / IT / CST / ITE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SE-EAE-1	SE-350T	Software Measurements, Metrics and Modelling	3		3
		SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-EAE-2A OR	SE-352T	Service Oriented Architecture	3		3
		SE-352P	Service Oriented Architecture Lab		2	1
	SE-EAE-2B	SE-354T	Software Project Management	3		3
		SE-354P	Software Project Management Lab		2	1
7	SE-EAE-3	SE-483T	Mining Software Repositories and Predictive Modelling	3		3
		SE-483P	Mining Software Repositories and Predictive Modelling Lab		2	1
7	SE-EAE-4A OR	SE-485	Software Security	4		4
	SE-EAE-4B	SE-487T	Software Verification, Validation and Testing	3		3
		SE-487P	Software Verification, Validation and Testing Lab		2	1
7	SE-EAE-5	SE-489	Software Engineering Standards	4		4

Emerging Area Specialization: Full Stack Development (for CSE / IT / CST / ITE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	FSD-EAE-1	FSD-318T	Advanced Java Programming	3		3
		FSD-318P	Advanced Java Programming Lab		2	1
6	FSD-EAE-2A OR	FSD-320T	Web Development using MEAN Stack	3		3
		FSD-320P	Web Development using MEAN Stack Lab		2	1
	FSD-EAE-2B	FSD-322T	Web Development using MERN Stack	3		3
		FSD-322P	Web Development using MERN Stack Lab		2	1
7	FSD-EAE-3	FSD-435T	PHP Programming and MySQL	3		3
		FSD-435P	PHP Programming and MySQL Lab		2	1
7	FSD-EAE-4	FSD-437T	Mobile App Development	3		3
		FSD-437P	Mobile App Develop Lab		2	1
7	FSD-EAE-5	FSD-439T	Web and Mobile Application Testing and Deployment	3		3
		FSD-43P	Web and Mobile Application Testing and Deployment Lab		2	1

Emerging Area Specialization: Image Processing and Computer Vision (for CSE/IT/CST/ITE/ECE/ EE / EEE / ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IPCV-EAE-1A OR	IPCV-334T	Digital Image Processing	3		3
		IPCV-334P	Digital Image Processing Lab		2	1
	IPCV-EAE-1B	IPCV-356T	Digital Signal and Image Processing	3		3
		IPCV-356P	Digital Signal and Image Processing Lab		2	1
6	IPCV-EAE-2	IPCV-336T	Pattern Recognition	3		3
		IPCV-336P	Pattern Recognition Lab		2	1
7	IPCV-EAE-3	IPCV-451T	Computer Vision	3		3
		IPCV-451P	Computer Vision Lab		2	1
7	IPCV-EAE-4A OR	IPCV-453T	Biometrics	3		3
		IPCV-453P	Biometrics Lab		2	1
	IPCV-EAE-4B OR	IPCV-455T	Medical Image Processing, Analysis and Reconstruction	3		3
		IPCV-455P	Medical Image Processing, Analysis and Reconstruction Lab		2	1
	IPCV-EAE-4C	IPCV-457T	Remote Sensing Image Analysis and Classification	3		3
		IPCV-457P	Remote Sensing Image Analysis and Classification Lab		2	1
7	IPCV-EAE-5A OR	IPCV-459T	Deep Learning for Image Processing and Computer Vision	3		3
		IPCV-459P	Deep Learning for Image Processing and Computer Vision Lab		2	1
	IPCV-EAE-5B	IPCV-461T	Machine Learning for Image and Vision Analysis	3		3
		IPCV-461P	Machine Learning for Image and Vision Analysis Lab		2	1

Emerging Area Specialization: Robotics and Automation (for ECE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	RA-EAE-1	RA-324T	Robot Kinematics and Dynamics	3		3
		RA-324P	Robot Kinematics and Dynamics Lab		2	1
6	RA-EAE-2	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
7	RA-EAE-3	RA-437T	Robot Actuation Systems	3		3
		RA-437P	Robot Actuation Systems Lab		2	1
7	RA-EAE-4	RA-439T	Control Hardware and Interfacing	3		3
		RA-439P	Control Hardware and Interfacing Lab		2	1
7	RA-EAE-5	RA-441T	AI in Robotics	3		3
		RA-441P	AI in Robotics Lab		2	1

Emerging Area Specialization: Embedded Systems (for CSE/IT/CST/ITE/ECE/EE/EEE /ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ES-EAE-1A OR	ES-302T	Microprocessors and Interfacing	3		3
		ES-302P	Microprocessors and Interfacing Lab		2	1
	ES-EAE-1B OR	ES-308T	Introduction to Data Communication and Networking	3		3
		ES-308P	Introduction to Data Communication and Networking Lab		2	1
	ES-EAE-1C	ES-310T	Advanced Microprocessors (ARM) & Interfacing	3		3
		ES-310P	Advanced Microprocessors (ARM) & Interfacing Lab		2	1
6	ES-EAE-2A OR	ES-304	Real Time Operating Systems	4		4
	ES-EAE-2B	ES-306T	Embedded System Architecture and Design	3		3
		ES-306P	Embedded System Architecture and Design Lab		2	1
7	ES-EAE-3A OR	ES-401T	Programming in C for Embedded Systems	3		3
		ES-401P	Programming in C for Embedded Systems Lab		2	1
	ES-EAE-3B	ES-403T	VHDL Programming	3		3
		ES-403P	VHDL Programming Lab		2	1
7	ES-EAE-4	ES-405T	Real Time Embedded System Programming	3		3
		ES-405P	Real Time Embedded System Programming Lab		2	1
7	ES-EAE-5A OR	ES-407T	Embedded Linux	3		3
		ES-407P	Embedded Linux Lab		2	1
	ES-EAE-5B OR	IOT-409T	Introduction to Sensors and Transducers	3		3
		IOT-409P	Introduction to Sensors and Transducers Lab		2	1
	ES-EAE-5C	ES-411T	Logic Design and Analysis using Verilog	3		3
		ES-411P	Logic Design and Analysis using Verilog Lab		2	1

Emerging Area Specialization: VLSI Design (for ECE/ EE /EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	VLSI-EAE-1	VLSI-328T	Semiconductor Devices and Modelling	3		3
		VLSI-328P	Semiconductor Devices and Modelling Lab		2	1
6	VLSI-EAE-2	VLSI-330T	VLSI	3		3
		VLSI-330P	VLSI Lab		2	1
7	VLSI-EAE-3	VLSI-443T	CMOS Analog Integrated Circuit Design	3		3
		VLSI-443P	CMOS Analog Integrated Circuit Design Lab		2	1
7	VLSI-EAE-4	VLSI-445T	CMOS Digital Circuits Design	3		3
		VLSI-445P	CMOS Digital Circuits Design Lab		2	1
7	VLSI-EAE-5A OR	VLSI-447	CMOS Mixed Signal Circuit Design	4		4
	VLSI-EAE-5B OR	VLSI-449T	Low Power VLSI Design	3		3
		VLSI-449P	Low Power VLSI Design Lab		2	1
	VLSI-EAE-5C	VLSI-451	VLSI Testing	4		4

Emerging Area Specialization: Wireless and Mobile Communications (for ECE/ EE /EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	WMC-EAE-1A OR	WMC-332T	Optical Networks	3		3
		WMC-332P	Optical Networks Lab		2	1
	WMC-EAE-1B OR	WMC-334T	Random Processes and Stochastic Systems	3		3
		WMC-334P	Random Processes and Stochastic Systems Lab		2	1
	WMC-EAE-1C	WMC-336T	Wireless Communication and Networks	3		3
		WMC-336P	Wireless Communication and Networks Lab		2	1
6	WMC-EAE-2	WMC-338	Cellular and Mobile Communication	3		3
		WMC-338P	Cellular and Mobile Communication Lab		2	1
7	WMC-EAE-3A OR	WMC-453T	Ad hoc and Sensor Networks	3		3
		WMC-453P	Ad hoc and Sensor Networks Lab		2	1
	WMC-EAE-3B	WMC-455T	Mobile Computing	3		3
		WMC-455P	Mobile Computing Lab		2	1
7	WMC-EAE-4	WMC-457	Cognitive Radio & Networks	4		4
7	WMC-EAE-5	WMC-459	Privacy and Security in Wireless Networks	4		4

Emerging Area Specialization: Electrical Vehicles (for EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	EV-EAE-1	EV-308T	Electric Vehicle Powertrain and Motor Design	3		3
		EV-308P	Electric Vehicle Powertrain and Motor Design Lab		2	1
6	EV-EAE-2	EV-310T	Battery Management Systems	3		3
		EV-310P	Battery Management Systems Lab		2	1
7	EV-EAE-3	EV-413T	EV Charging Infrastructure Technology	3		3
		EV-413P	EV Charging Infrastructure Technology Lab		2	1
7	EV-EAE-4	EV-415	Economics and Policies of e-Mobility	4		4
7	EV-EAE-5	EV-417T	Embedded Systems for Electric Vehicles	3		3
		EV-417P	Embedded Systems for Electric Vehicles Lab		2	1

Emerging Area Specialization: Microgrid Technologies (for EE / EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	MT-EAE-1	MT-312T	Energy Storage Systems in Microgrids	3		3
		MT-312P	Energy Storage Systems in Microgrids Lab		2	1
6	MT-EAE-2	MT-314T	Modeling and Analysis of Microgrids	3		3
		MT-314P	Modeling and Analysis of Microgrids Lab		2	1
7	MT-EAE-3	MT-419T	Microgrid Stability Assessment and Protection	3		3
		MT-419P	Microgrid Stability Assessment and Protection Lab		2	1
7	MT-EAE-4	MT-421T	Human Machine Interface for Microgrids	3		3
		MT-421P	Human Machine Interface for Microgrids Lab		2	1
7	MT-EAE-5	MT-423T	Power Quality for Microgrids	3		3
		MT-423P	Power Quality for Microgrids Lab		2	1

Emerging Area Specialization: Power Systems (for EE / EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	PS-EAE-1	PS-320T	Electricity Generation, Transmission and Utilization	3		3
		PS-320P	Electricity Generation, Transmission and Utilization Lab		2	1
6	PS-EAE-2	PS-322T	EHVAC and HVDC Transmission	3		3
		PS-322P	EHVAC and HVDC Transmission Lab		2	1
7	PS-EAE-3	PS-431T	Power System Operation and Control	3		3
		PS-431P	Power System Operation and Control Lab		2	1
7	PS-EAE-4	PS-433T	Flexible AC Transmission System	3		3
		PS-433P	Flexible AC Transmission System Lab		2	1
7	PS-EAE-5	PS-435T	Power System Analysis and Stability	3		3
		PS-435P	Power System Analysis and Stability Lab		2	1

Emerging Area Specialization: Power Electronics and Drives (for EE / EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	PED-EAE-1	PED-316T	Advanced Power Electronic Converters	3		3
		PED-316P	Advanced Power Electronic Converters Lab		2	1
6	PED-EAE-2	PED-318T	Industrial Control Electronics	3		3
		PED-318P	Industrial Control Electronics Lab		2	1
7	PED-EAE-3	PED-425T	Switch Mode Power Conversion	3		3
		PED-425P	Switch Mode Power Conversion Lab		2	1
7	PED-EAE-4	PED-427T	Solid State Drives	3		3
		PED-427P	Solid State Drives Lab		2	1
7	PED-EAE-5	PED-429T	Solar Photovoltaic Systems	3		3
		PED-429P	Solar Photovoltaic Systems Lab		2	1

Emerging Area Specialization: Control and Instrumentation (for EE / EEE / ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CI-EAE-1	CI-306T	PLC and SCADA Systems	3		3
		CI-306P	PLC and SCADA Systems Lab		2	1
6	CI-EAE-2	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
7	CI-EAE-3	CI-407T	Advanced Control Systems for Instrumentation	3		3
		CI-407P	Advanced Control Systems for Instrumentation Lab		2	1
7	CI-EAE-4	CI-409T	Neuro Fuzzy Systems	3		3
		CI-409P	Neuro Fuzzy Systems Lab		2	1
7	CI-EAE-5	CI-411T	Non-linear System Design	3		3
		CI-411P	Non-linear System Design Lab		2	1

Emerging Area Specialization: Computer Aided Design and Manufacturing (for ME)

Semester	Group	Paper Code	Paper Name	L	P	Credits
6	CADM-EAE-1	CADM-302T	Introduction to CAD/CAM	3		3
		CADM-302P	Introduction to CAD/CAM Lab		2	1
6	CADM-EAE-2	CADM-304T	Injection Moulding and Mould Design	3		3
		CADM-304P	Injection Moulding and Mould Design Lab		2	1
7	CADM-EAE-3	CADM-401T	Computational Fluid Dynamics	3		3
		CADM-401P	Computational Fluid Dynamics Lab		2	1
7	CADM-EAE-4	CADM-403T	Computer Aided Design and Drafting	3		3
		CADM-403P	Computer Aided Design and Drafting Lab		2	1
7	CADM-EAE-5	CADM-405T	Industrial Robotics	3		3
		CADM-405P	Industrial Robotics Lab		2	1

Emerging Area Specialization: Design and Measurement Systems (for ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	DMS-EAE-1	DMS-312T	Industrial Tribology	3		3
		DMS-312P	Industrial Tribology Lab		2	1
6	DMS-EAE-2	DMS-314T	Quality Management & Quality Control	3		3
		DMS-314P	Quality Management & Quality Control Lab		2	1
7	DMS-EAE-3	DMS-419T	Fracture Mechanics	3		3
		DMS-419P	Fracture Mechanics Lab		2	1
7	DMS-EAE-4	DMS-421T	Advance Manufacturing Process	3		3
		DMS-421P	Advance Manufacturing Process Lab		2	1
7	DMS-EAE-5	DMS-423T	Pressure vessels and Piping Technology	3		3
		DMS-423P	Pressure vessels and Piping Technology Lab		2	1

Emerging Area Specialization: Design Trends (for EE / EEE / ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	DT-EAE-1	DMS-314T	Quality Management & Quality Control	3		3
		DMS-314P	Quality Management & Quality Control Lab		2	1
6	DT-EAE-2	DT-316T	Automobile Engineering	3		3
		DT-316P	Automobile Engineering Lab		2	1
7	DT-EAE-3	DMS-421T	Advance Manufacturing Process	3		3
		DMS-421P	Advance Manufacturing Process Lab		2	1
7	DT-EAE-4	DT-425T	Mechanical Vibrations	3		3
		DT-425P	Mechanical Vibrations Lab		2	1
7	DT-EAE-5	DT-427T	Industrial Tribology	3		3
		DT-427P	Industrial Tribology Lab		2	1

Emerging Area Specialization: Thermal Energy Sources (for ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	TES-EAE-1	TES-330T	Cryogenic Engineering	3		3
		TES-330P	Cryogenic Engineering Lab		2	1
6	TES-EAE-2	TES-332T	Energy Systems and Technologies	3		3
		TES-332P	Energy Systems and Technologies Lab		2	1
7	TES-EAE-3	TES-447T	Compressible Flow and Jet Propulsion	3		3
		TES-447P	Compressible Flow and Jet Propulsion Lab		2	1
7	TES-EAE-4	TES-449T	Green Energy Technology	3		3
		TES-449P	Green Energy Technology Lab		2	1
7	TES-EAE-5	TES-451T	Advanced IC Engines	3		3
		TES-451P	Advanced IC Engines Lab		2	1

Emerging Area Specialization: Quality Management (for ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	QM-EAE-1	QM-326T	Supply Chain Management	3		3
		QM-326P	Supply Chain Management Lab		2	1
6	QM-EAE-2	QM-328T	Flexible Manufacturing Systems	3		3
		QM-328P	Flexible Manufacturing Systems Lab		2	1
7	QM-EAE-3	QM-441T	Total Quality Management	3		3
		QM-441P	Total Quality Management Lab		2	1
7	QM-EAE-4	QM-443T	Statistical Quality Control	3		3
		QM-443P	Statistical Quality Control Lab		2	1
7	QM-EAE-5	QM-445	Organizational Behaviour	4		4

Emerging Area Specialization: Construction Technology and Management (for CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CTM-EAE-1	CEC-308	Contract Management	4		4
6	CTM-EAE-2	CEC-310	Advanced Construction Materials and Practices	4		4
7	CTM-EAE-3	CEC-413	Quality and Safety Management	4		4
7	CTM-EAE-4	CEC-415	Lean Construction Technology and Management	4		4
7	CTM-EAE-5	CEC-417	Recent Construction Technologies	4		4

Emerging Area Specialization: Infrastructure Engineering (for CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IE-EAE-1	IE-322	Water Resource Planning	4		4
6	IE-EAE-2	IE-324	Advanced Environmental Engineering and Design	4		4
7	IE-EAE-3	IE-435	Metro Systems Engineering	4		4
7	IE-EAE-4	IE-437T	Transport Planning and Intelligent Transportation System	3		3
		IE-437P	Transport Planning and Intelligent Transportation System Lab		2	1
7	IE-EAE-5	IE-439	Analysis and Design of High-rise Buildings and Bridges	4		4

Emerging Area Specialization: Green Technology and Sustainability Engineering (for CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	GTSE-EAE-1	GTSE-318	Planning and Design of Green Buildings	4		4
6	GTSE-EAE-2	GTSE-320	Sustainable Materials and Practices	4		4
7	GTSE-EAE-3	GTSE-429	Green Energy Concepts in Smart Cities	4		4
7	GTSE-EAE-4	GTSE-431	Intelligent Transportation System	4		4
7	GTSE-EAE-5	GTSE-433	Sustainable Engineering Technologies	4		4

Open Area Elective Groups (for Minor Specialization) – Applicable only for Core Disciplines (OAE)

The minor specialization is offered through a set of five papers that the student has to study to acquire the minor specialization. The number of papers to be studied is two in 6th semester and three in 7th semester. The minor specialization shall be awarded if and only if 20 credits are earned from an individual / specific minor specialization area. From each paper group associated with a paper paper slot in a particular semester, the student shall be allowed to study only one paper group. The papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Minor specialization is not necessary for award of the degree, the student may choose five papers from the groups offered by the institution to a particular student (belonging to a major discipline) across groups. Minimum two minor specialization groups should be offered by the institution to students of any particular major discipline from either of the open area or emerging area groups.

An elective shall be offered to the student for each Minor Specialization group in Open Area (That is for OAE-1, OAE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required. The nomenclature of the paper group is <ACRONYM OF EMERGING AREA> - OAE - <SLOT NUMBER><A or B or C etc., if required>. The major disciplines to which the open Area Elective Group papers can be offered is specified as acronym together with the name of the minor specialization.

In lieu of Open Area Elective, students can study papers from Emerging Area Elective groups also as offered to them.

The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as Open Area Electives to engineering students (approved by the University Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for Open Area Electives.

Open Area Specialization: Computer Science and Engineering (for ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CSE-OAE-1A OR	OCSE-306T	C++ Programming	3		3
		OCSE-306P	C++ Programming Lab		2	1
	CSE-OAE-1B	OCSE-308	Digital Logic and Computer Design	4		4
6	CSE-OAE-2A OR	OCSE-310T	Data Structures and Algorithms	3		3
		OCSE-310P	Data Structures and Algorithms Lab		2	1
	CSE-OAE-2B	OCSE-342T	Programming in Java	3		3
		OCSE-342P	Programming in Java Lab		2	1
7	CSE-OAE-3	OCSE-407T	Introduction to Database Management Systems	3		3
		OCSE-407P	Introduction to Database Management Systems Lab		2	1
7	CSE-OAE-4	OCSE-409	Operating Systems	4		4
7	CSE-OAE-5A OR	OCSE-411T	Introduction to Computer Networks	3		3
		OCSE-411P	Introduction to Computer Networks Lab		2	1
	CSE-OAE-5B	OCSE-413T	Introduction to Software Engineering	3		3
		OCSE-413P	Introduction to Software Engineering Lab		2	1

Open Area Specialization: Electronics and Communications Engineering (for CSE / IT / CST / ITE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ECE-OAE-1AOR	OECE-312T	Introduction to Circuits and Systems	3		3
		OECE-312P	Introduction to Circuits and Systems Lab		2	1
	ECE-OAE-1B	OECE-344T	Introduction to Analog Electronics	3		3
		OECE-344P	Introduction to Analog Electronics Lab		2	1
6	ECE-OAE-2	OECE-314T	Electronic Devices and Circuits	3		3
		OECE-314P	Electronic Devices and Circuits Lab		2	1
7	ECE-OAE-3A OR	OECE-415	Digital Logic and Computer Design	4		4
	ECE-OAE-3B	OECE-417T	Microprocessors and Interfacing	3		3
		OECE-417P	Microprocessors and Interfacing Lab		2	1
7	ECE-OAE-4A OR	OECE-419T	Analog and Digital Communications	3		3
		OECE-419P	Analog and Digital Communications Lab		2	1
	ECE-OAE-4B	OECE-421T	Wireless Sensor Networks	3		3
		OECE-421P	Wireless Sensor Networks Lab		2	1
7	ECE-OAE-5A OR	OECE-423	Control Systems	4		4
	ECE-OAE-5B	OECE-425T	Introduction to Computer Networks	3		3
		OECE-425P	Introduction to Computer Networks Lab		2	1

Open Area Specialization: Electrical Engineering (for CSE / IT / CST / ITE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	EE-OAE-1A OR	OEE-316T	Introduction to Circuits and Systems	3		3
		OEE-316P	Introduction to Circuits and Systems Lab		2	1
	EE-OAE-1B	OEE-346T	Introduction to Analog Electronics	3		3
		OEE-346P	Introduction to Analog Electronics Lab		2	1
6	EE-OAE-2	OEE-318T	Introduction to Electrical Machines	3		3
		OEE-318P	Introduction to Electrical Machines Lab		2	1
7	EE-OAE-3	OEE-427T	Control Systems for Electrical Engineering	3		3
		OEE-427P	Control Systems for Electrical Engineering Lab		2	1
7	EE-OAE-4	OEE-429T	Generation, Transmission and Distribution	3		3
		OEE-429P	Generation, Transmission and Distribution Lab		2	1
7	EE-OAE-5	OEE-431T	Introduction to Power Electronics	3		3
		OEE-431P	Introduction to Power Electronics Lab		2	1

Open Area Specialization: Software Development (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SD-OAE-1A OR	OSD-328T	C++ Programming	3		3
		OSD-328P	C++ Programming Lab		2	1
	SD-OAE-1B OR	OSD-330T	Programming in Windows Environment	3		3
		OSD-330P	Programming in Windows Environment Lab		2	1
	SD-OAE-1C	OSD-332T	Programming in Java	3		3
		OSD-332P	Programming in Java Lab		2	1
6	SD-OAE-2A OR	OSD-334T	Android App Development	3		3
		OSD-334P	Android App Development Lab		2	1
	SD-OAE-2B	OSD-336T	Introduction to Database Management Systems	3		3
		OSD-336P	Introduction to Database Management Systems Lab		2	1
7	SD-OAE-3A OR	OSD-445T	Data Structures and Algorithms	3		3
		OSD-445P	Data Structures and Algorithms Lab		2	1
	SD-OAE-3B	OSD-447T	Project Management	3		3
		OSD-447P	Project Management Lab		2	1
7	SD-OAE-4A OR	OSD-449T	Design Patterns	3		3
		OSD-449P	Design Patterns Lab		2	1
	SD-OAE-4B	OSD-451T	Introduction to Software Engineering	3		3
		OSD-451P	Introduction to Software Engineering Lab		2	1
7	SD-OAE-5A OR	OSD-453T	Advanced Java Programming	3		3
		OSD-453P	Advanced Java Programming Lab		2	1
	SD-OAE-5B	OSD-455T	Programming in Linux Environment	3		3
		OSD-455P	Programming in Linux Environment Lab		2	1

Open Area Specialization: Mechanical Engineering (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ME-OAE-1	OME-324T	Theory of Machines	3		3
		OME-324P	Theory of Machines Lab		2	1
6	ME-OAE-2	OME-326T	Materials and Machine Technology	3		3
		OME-326P	Materials and Machine Technology Lab		2	1
7	ME-OAE-3	OME-439T	Fluids and Thermal Engineering	3		3
		OME-439P	Fluids and Thermal Engineering Lab		2	1
7	ME-OAE-4	OME-441T	Mechanics and Design of Solids	3		3
		OME-441P	Mechanics and Design of Solids Lab		2	1
7	ME-OAE-5	OME-443T	Automation in Manufacturing	3		3
		OME-443P	Automation in Manufacturing Lab		2	1

Open Area Specialization: Instrumentation and Control Engineering (for CSE / IT / CST / ITE / ECE / EE / EEE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ICE-OAE-1	OICE-320T	Introduction to Sensors and Transducers	3		3
		OICE-320P	Introduction to Sensors and Transducers Lab		2	1
6	ICE-OAE-2	OICE-322T	Measurement and Control	3		3
		OICE-322P	Measurement and Control Lab		2	1
7	ICE-OAE-3	OICE-433	Process Control	4		4
7	ICE-OAE-4	OICE-435T	Introduction to Industrial Instrumentation	3		3
		OICE-435P	Introduction to Industrial Instrumentation Lab		2	1
7	ICE-OAE-5	OICE-437T	Bio Medical Instrumentation	3		3
		OICE-437P	Bio Medical Instrumentation Lab		2	1

Open Area Specialization: Civil Engineering (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CE-OAE-1	OCE-302	Structural Analysis and Design	4		4
6	CE-OAE-2	OCE-304	Pipe and Open Channel Hydraulics	4		4
7	CE-OAE-3	OCE-401	Green Building Construction Materials and Practices	4		4
7	CE-OAE-4	OCE-403	Public Health Engineering	4		4
7	CE-OAE-5	OCE-405	Geotechnical and Transportation Engineering	4		4

Open Area Specialization: Universal Human Values (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	UHV-OAE-1	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	UHV-OAE-2	OUHV-340	Vision for Humane Society	4		4
7	UHV-OAE-3A OR	OUHV-457	Human Values and Madhyasth Darshan	4		4
	UHV-OAE-3B OR	OUHV-459	Human Values in Buddh and Jain Darshan	4		4
	UHV-OAE-3C	OUHV-461	Human Values in Vedic Darshan (Sankhya, Yoga and Vedanta)	4		4
7	UHV-OAE-4A OR	OUHV-463	Holistic Human Health	4		4
	UHV-OAE-4B	OUHV-465	Human Sociology	4		4
7	UHV-OAE-5	OUHV-467	Human Economics	4		4

2nd Year Onward Scheme and Implementation Guideline forBachelor of Technology Programme(s) in Emerging AreasDisciplines:

The programmes in the emerging areas shall have the first year curriculum as specified in the beginning of this document. The fundamental change in these programmes is that these programmes are oriented towards not only core area expertise but also expertise in emerging areas and multi-disciplinary areas(s) of engineering and technology. Therefore, the major change in the structure of the curriculum vis-à-vis the core area programme is reduction in the number of electives so that emerging areas can be given a complete coverage. The following emerging area and / or multi-disciplinary area degree programmes shall be offered:

1. **Mechanical and Automation Engineering (MAE)**
2. **Computer Science and Engineering (Artificial Intelligence) (CSE-AI)**
3. **Computer Science and Engineering (Artificial Intelligence and Machine Learning) (CSE-AIML)**
4. **Computer Science and Engineering (Data Science) (CSE-DS)**
5. **Computer Science and Engineering (Internet of Things) (CSE-IoT)**
6. **Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) (CSE-ICB)**
7. **Computer Science and Engineering (Networks) (CSE-Net)**
8. **Computer Science and Engineering (Cyber Security) (CSE-CS)**

Bachelor of Technology in Mechanical and Automation Engineering (MAE)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	MEC-205	Theory of Machines	4		4
PC	MEC-207	Strength of Materials	4		4
PC	MEC-209	Manufacturing Science and Technology-I	4		4
PC	ECC-217	Analog and Digital Electronics	3		3
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	MEC-253	Theory of Machines Lab		2	1
PC	MEC-255	Strength of Materials Lab		2	1
PC	MEC-259	Manufacturing Science and Technology-I Lab		2	1
PC	ECC-263	Analog and Digital Electronics Lab		2	1
Total			**21**	**10**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	MEC-206	Manufacturing Science and Technology-II	4		4
PC	MEC-208	Material Science and Metallurgy	4		4
PC	MAC-210	Database Management Systems	4		4
PC	MAC-212	Thermodynamics and Applications	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	MEC-254	Manufacturing Science and Technology-II Lab		2	1
PC	MAC-256	Database Management Systems Lab		2	1
PC	MAC-258	Thermodynamics and Applications Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	MEC-303	Machine Design-I	4		4
PC	MEC-305	Heat and Mass Transfer	4		4
PC	MEC-309	Industrial Engineering	4		4
PC	MAC-311	Sensors and Transducers	4		4
PC	MAC-313	Control Systems and Applications	3		3
Practical / Viva Voce					
PC	MEC-351	Machine Design-I Lab		2	1
PC	MEC-353	Heat and Mass Transfer Lab		2	1
PC	MAC-355	Sensors and Transducers Lab		2	1
PC	MAC-359	Control Systems and Applications Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**21**	**5**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Universal Human Values*	1		1
PC	MEC-306	Machine Design-II	4		4
PC	MEC-308	Fluid Mechanics and Hydraulic Machines	4		4
PC	MAC-310	Mechatronics	4		4
PC	MAC-312	CAD/CAM	4		4
Practical / Viva Voce					
PC	MEC-352	Machine Design-II Lab		2	1
PC	MEC-354	Fluid Mechanics and Hydraulic Machines Lab		2	1
PC	MAC-356	Mechatronics Lab		2	1
PC	MAC-358	CAD/CAM Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club**			2
Total			**20**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	MAC-403	Computer Integrated Manufacturing	3		3
PC	MAC-405	Embedded Systems and Internet of Things	3		3
PC	MAC-407	Introduction to Metrology and Instrumentation	3		3
PC	MAC-409	Robotics Engineering	3		3
OAE		Open Area Elective Paper (OAE)			4
Practical / Viva Voce					
PC	MAC-455	Computer Integrated Manufacturing Lab		2	1
PC	MAC-457	Embedded Systems and Internet of Things Lab		2	1
PC	MAC-459	Introduction to Metrology and Instrumentation Lab		2	1
PC	MAC-461	Robotics Engineering Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training Report - 2 *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES**: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE (Choose Any One)	L	P	Credits
7	MAO-411T	Additive Manufacturing	3		3
	MAO-411P	Additive Manufacturing Lab		2	1
7	MAO-413T	Advance Metal Cutting and Tool Design	3		3
	MAO-413P	Advance Metal Cutting and Tool Design Lab		2	1
7	MAO-415T	Automation in Manufacturing	3		3
	MAO-415P	Automation in Manufacturing Lab		2	1
7	MAO-417T	Data Science	3		3
	MAO-417P	Data Science Lab		2	1
7	MAO-419T	Design of Experiments	3		3
	MAO-419P	Design of Experiments Lab		2	1
7	MAO-421T	Design of Mechanical Assemblies	3		3
	MAO-421P	Design of Mechanical Assemblies Lab		2	1
7	MAO-423T	Design of Mechanical Drives	3		3
	MAO-423P	Design of Mechanical Drives Lab		2	1
7	MAO-425T	Geometric Modelling and Analysis	3		3
	MAO-425P	Geometric Modelling and Analysis Lab		2	1
7	MAO-427	Non Traditional Manufacturing	4		4
7	MAO-429T	Rapid prototyping Tooling and Manufacturing	3		3
	MAO-429P	Rapid prototyping Tooling and Manufacturing Lab		2	1
7	MAO-431T	Artificial Intelligence and Machine Learning	3		3
	MAO-431P	Artificial Intelligence and Machine Learning Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required. The nomenclature of the paper code is <*MAO*> - <PAPER CODE><T (for Theory or P (for practical)., if required>.

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	20	20	20	**122**	**108**
OAE						4		**4**	**0**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme.

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	20	20	20	**122**	**108**
OAE					4		**4**	**0**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also.
7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.
8. The students may take 1 subject from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.
9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

        The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Mechanical and Automation Engineering";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Mechanical and Automation Engineering (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Mechanical and Automation Engineering".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence) (CSE-AI)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Introduction to Universal Human Values*	1		1
PC	AI-302T	Artificial Intelligence	3		3
PC	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
PC	AI-318T	Fuzzy Systems and Applications	3		3
PC	ML-350T	Artificial Neural Networks	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	AI-302P	Artificial Intelligence Lab		2	1
PC	DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
PC	AI-318P	Fuzzy Systems and Applications Lab		2	1
PC	ML-350P	Artificial Neural Networks Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	AI-403T	Artificial Intelligence Applications	3		3
PC	AI-405T	Intelligent and Expert Systems	3		3
PC	AI-407T	Evolutionary Computation	3		3
PC	AI-409T	Natural Language Processing	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	AI-403P	Artificial Intelligence Applications Lab		2	1
PC	AI-405P	Intelligent and Expert Systems Lab		2	1
PC	AI-407P	Evolutionary Computation Lab		2	1
PC	AI-409P	Natural Language Processing Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

**The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
    i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
    ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
    iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
    i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
    ii. Practical File - 10 Marks
    iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

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2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

        The degree nomenclature of the degree shall be as: “***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence)”;*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: “***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence) (Honours)***”, if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) (CSE-AIML)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Introduction to Universal Human Values*	1		1
PC	AI-302T	Artificial Intelligence	3		3
PC	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
PC	AI-320T	Optimization Techniques	3		3
PC	ML-352T	Supervised and Unsupervised Learning	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	AI-302P	Artificial Intelligence Lab		2	1
PC	DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
PC	AI-320P	Optimization Techniques Lab		2	1
PC	ML-352P	Supervised and Unsupervised Learning Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	SC-401T	Soft Computing	3		3
PC	ML-407T	Machine Learning	3		3
PC	ML-409T	Reinforcement Learning and Deep Learning	3		3
PC	ML-411T	Pattern Recognition and Computer Vision	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	SC-401P	Soft Computing Lab		2	1
PC	ML-407P	Machine Learning Lab		2	1
PC	ML-409P	Reinforcement Learning and Deep Learning Lab		2	1
PC	ML-411P	Pattern Recognition and Computer Vision Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

**The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479PT	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	**Semester (Credits)**						**Total Credits**	**Mandatory Credits**
	III	**IV**	**V**	**VI**	**VII**	**VIII**		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Data Science) (CSE-DS)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Introduction to Universal Human Values*	1		1
PC	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
PC	AI-316T	Artificial Intelligence and Machine Learning	3		3
PC	DS-342T	Programming in R and Python	3		3
PC	DS-344T	Data Pre-processing and Post Processing	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
PC	AI-316P	Artificial Intelligence and Machine Learning Lab		2	1
PC	DS-342P	Programming in R and Python Lab		2	1
PC	DS-344P	Data Pre-processing and Post Processing Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	DS-427T	Data Science using R	3		3
PC	DS-429T	Big Data Analytics	3		3
PC	DS-431T	Business Intelligence	3		3
PC	DS-433T	Exploratory Data Analytics and Data Visualization	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	DS-427P	Data Science using R Lab		2	1
PC	DS-429P	Big Data Analytics Lab		2	1
PC	DS-431P	Business Intelligence Lab		2	1
PC	DS-433P	Exploratory Data Analytics and Data Visualization Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

**The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   - iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   - i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   - ii. Practical File - 10 Marks
   - iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme**.**

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15^{th} July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

       i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

       ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Data Science)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Data Science) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Data Science)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Internet of Things) (CSE-IoT)

2^{nd} Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Introduction to Universal Human Values*	1		1
PC	IOT-320T	Programming in Python	3		3
PC	IOT-324T	Introduction to Internet of Things	3		3
PC	IOT-326T	Introduction to Sensors and Transducers	3		3
PC	IOT-328T	Wireless Sensor Networks	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	IOT-320P	Programming in Python Lab		2	1
PC	IOT-324P	Introduction to Internet of Things Lab		2	1
PC	IOT-326P	Introduction to Sensors and Transducers Lab		2	1
PC	IOT-328P	Wireless Sensor Networks Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
PC	IOT-443T	Design of Smart Systems	3		3
PC	IOT-447T	Internet of Things Frameworks	3		3
PC	IOT-449T	Privacy and Security issues in IoT	4		4
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
PC	IOT-443P	Design of Smart Systems Lab		2	1
PC	IOT-447P	Internet of Things Frameworks Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

**The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

       i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

       ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

       The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Internet of Things)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering(Internet of Things and Cyber Security including Block Chain Technology) (CSE-ICB)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Introduction to Universal Human Values*	1		1
PC	BT-308T	Blockchain Technology	3		3
PC	IOT-320T	Programming in Python	3		3
PC	IOT-324T	Introduction to Internet of Things	3		3
PC	IOT-326T	Introduction to Sensors and Transducers	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	BT-308P	Blockchain Technology Lab		2	1
PC	IOT-320P	Programming in Python Lab		2	1
PC	IOT-324P	Introduction to Internet of Things Lab		2	1
PC	IOT-326P	Introduction to Sensors and Transducers Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	BT-415T	Smart Contracts	3		3
PC	CS-421	Cyber Crime and Cyber Laws	4		4
PC	CS-427T	Network Security and Cryptography	3		3
PC	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	BT-415P	Smart Contracts Lab		2	1
PC	CS-427P	Network Security and Cryptography Lab		2	1
PC	IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	**Semester (Credits)**							**Total Credits**	**Mandatory Credits**
	I & II	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

    The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1 or Table 2 (as applicable)** and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Internet of Things and Cyber Security including Block Chain Technology)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Networks) (CSE-NET)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:** All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Introduction to Universal Human Values*	1		1
PC	CS-312T	Network Security and Cryptography	3		3
PC	WMC-340T	Wireless Communication and Networks	3		3
PC	NET-344T	Advanced Computer Networks and Administration	3		3
PC	NET-346T	Linux System Administration	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	CS-312P	Network Security and Cryptography Lab		2	1
PC	WMC-340P	Wireless Communication and Networks Lab		2	1
PC	NET-344P	Advanced Computer Networks and Administration Lab		2	1
PC	NET-346P	Linux System Administration Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	NET-471T	Network Programming	3		3
PC	NET-473T	Cloud Computing and Security	3		3
PC	NET-475T	Wireless Sensor Networks	3		3
PC	NET-477T	Network Simulation and Optimization	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	NET-471P	Network Programming Lab		2	1
PC	NET-473P	Cloud Computing and Security Lab		2	1
PC	NET-475P	Wireless Sensor Networks Lab		2	1
PC	NET-477P	Network Simulation and Optimization Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES**:Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

******The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES**: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.
ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.
(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test* - 15 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Assignments / Project / Quiz / Case Studies, etc. - 5 Marks
   iii. Attendance / Class Participation - 5 Marks
(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:
   i. Mid-Term Test and Viva Voce - 20 Marks (after 8 weeks of teaching or as decided by PCC)
   ii. Practical File - 10 Marks
   iii. Attendance / Lab Participation - 10 Marks

**** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.
The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term "major discipline" / "primary discipline" in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.
2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students' minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students' maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.
4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***
5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

        The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Networks)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Networks) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Networks)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Bachelor of Technology in Computer Science and Engineering (Cyber Security) (CSE-CS)

2nd Year Onward Scheme and implementation guideline

Third Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
ES	ES-201	Computational Methods	4		4
HS/MS	HS-203	Indian Knowledge System*	2		2
PC	CIC-205	Discrete Mathematics	4		4
PC	ECC-207	Digital Logic and Computer Design	4		4
PC	CIC-209	Data Structures	4		4
PC	CIC-211	Object-Oriented Programming using C++	4		4
Practical / Viva Voce					
ES	ES-251	Computational Methods Lab		2	1
PC	ECC-253	Digital Logic and Computer Design Lab		2	1
PC	CIC-255	Data Structures Lab		2	1
PC	CIC-257	Object-Oriented Programming using C++ Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fourth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
BS	BS-202	Probability, Statistics and Linear Programming	4		4
HS/MS	HS-204	Technical Writing*	2		2
PC	CIC-206	Theory of Computation	4		4
PC	EEC-208	Circuits and Systems	4		4
PC	CIC-210	Database Management Systems	4		4
PC	CIC-212	Programming in Java	4		4
Practical / Viva Voce					
BS	BS-252	Probability, Statistics and Linear Programming Lab		2	1
PC	EEC-254	Circuits and Systems Lab		2	1
PC	CIC-256	Database Management Systems Lab		2	1
PC	CIC-258	Programming in Java Lab		2	1
Total			**22**	**8**	**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

Fifth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	HS-301	Economics for Engineers	2		2
PC	CIC-303	Compiler Design	3		3
PC	CIC-305	Operating Systems	4		4
PC	CIC-307	Computer Networks	4		4
PC	CIC-309	Software Engineering	3		3
PC	CIC-311	Design and Analysis of Algorithm	4		4
Practical / Viva Voce					
PC	CIC-351	Compiler Design Lab		2	1
PC	CIC-353	Operating Systems Lab		2	1
PC	CIC-355	Computer Networks Lab		2	1
PC	CIC-357	Software Engineering Lab		2	1
PC	CIC-359	Design and Analysis of Algorithm Lab		2	1
PC / Internship	ES-361	Summer Training Report - 1 *			1
Total		-	**20**	**10**	**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 1 (after 4th Semester) shall be doneby the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

Sixth Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-302	Principles of Management for Engineers	3		3
HS/MS	HS-304	Introduction to Universal Human Values*	1		1
PC	BT-308T	Blockchain Technology	3		3
PC	CS-310T	Information Theory and Coding	3		3
PC	CS-312T	Network Security and Cryptography	3		3
PC	CS-316T	Cloud Computing and Security	3		3
OAE		Open Area Elective Paper (OAE – 1)			4
Practical / Viva Voce					
PC	BT-308P	Blockchain Technology Lab		2	1
PC	CS-310P	Information Theory and Coding Lab		2	1
PC	CS-312P	Network Security and Cryptography Lab		2	1
PC	CS-316P	Cloud Computing and Security Lab		2	1
HS/MS	HS-352	NSS / NCC / Cultural Clubs / Technical Society / Technical Club*			2
Total					**26**

***NUES:**All examinations to be conducted by the concerned teacher as specified in the detailed syllabus of the paper.

****NUES:** Comprehensive evaluation of the students by the concerned coordinator of NCC / NSS / Cultural Clubs / Technical Society / Technical Clubs, out of 100 as per the evaluation schemes worked out by these activity societies, organizations; the faculty co-ordinators shall be responsible for the evaluation of the same. These activities shall start from the 1st semester and the evaluation shall be conducted at the end of the 6th semester for students admitted in the first semester. Students admitted in the 2nd year (3rd semester) as lateral entry shall be evaluated on the basis their performance, by the faculty co-ordinator for the period of 3rd semester to 6th semester only.

Seventh Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Theory Papers					
HS/MS	MS-401	Principles of Entrepreneurship Mindset	2		2
PC	CS-421	Cyber Crime and Cyber Laws	4		4
PC	CS-423T	Cyber Security and Forensics	3		3
PC	CS-425T	Ethical Hacking	3		3
PC	CS-429T	Network Security Issues and Challenges	3		3
OAE		Open Area Elective Paper (OAE – 2)			4
Practical / Viva Voce					
PC	CS-423P	Cyber Security and Forensics Lab		2	1
PC	CS-425P	Ethical Hacking Lab		2	1
PC	CS-429P	Network Security Issues and Challenges Lab		2	1
PC / Project	ES-451	Minor Project**			3
PC / Internship	ES-453	Summer Training (after 6th semester) Report *			1
Total					**26**

***NUES:**Comprehensive evaluation of the Summer Training Report – 2 (after 6th Semester) shall be done by the committee of teachers, constituted by the Academic Programme Committee, out of 100. The training shall be of 4 to 6 weeks duration. The training can be under the mentorship of a teacher of the institute.

****The student shall be allocated a supervisor / guide for project work at the end 6th semester by the department / institution, the project shall continue into the 8th semester. In the 7th semester evaluation, the criteria for evaluation shall be conceptualization of the project work, the background study / literature survey and identification of objectives and methodology to be followed for project. 40 marks evaluation for the Teachers' Continuous Evaluation / Internal Assessment shall be done by concerned supervisor while the term end examination of 60 marks shall be conducted by the supervisor concerned and the external examiner deputed by the Examinations Division. In the absence of the supervisor, the Director of the Institution / Head of the Department can assign the responsibility of the supervisor (for purpose of examinations) to any faculty of the Institution / Department.

Eight Semester					
Group	**Paper Code**	**Paper**	**L**	**P**	**Credits**
Practical / Viva Voce%					
PC / Project	ES-452	Major Project – Dissertation and Viva Voce#			18
	ES-454	Project Progress Evaluation*			2
PC / Internship	ES-456	Internship Report and Viva Voce#			18
	ES-458	Internship Progress Evaluation*			2
Total			**0**	**0**	**20**

***NUES: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.**

%By default every student shall do the project work (ES-452 and ES-454). A student shall either be allowed to do a project work (ES-452 and ES-454) or an internship (ES-456 and ES-458). The student must apply for approval to do internship before the commencement of the 8th semester to the institute, and only after approval of Principal / Director of the institute through Training and Placement Officer of the institute, shall proceed for internship.

#Students may be allowed to do internship in this semester in lieu of Major project. The students allowed to proceed for internship shall be required to maintain a log-book of activities performed during internship. The same has to be countersigned by the mentor at the organization where internship is completed.

ES-452: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the supervisor. And, 60 marks by a bench of the supervisor and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

ES-454 / ES-458: Comprehensive evaluation by the committee of teachers, constituted by the Academic Programme Committee, out of 100.

ES-456: Evaluation shall be conducted of 40 marks (Teachers' continuous evaluation / internal assessment) by the Training and Placement Officer of the department / institute on the basis of the report submitted by the student. And, 60 marks by a bench of the Training and Placement Officer of the department / institute and the external examiner deputed by Examination Division (COE), for a total of 100 marks.

In the absence of the supervisor or the Training and Placement Officer (as the case may be), the Director of the institute / Head of the Department can assign the responsibility of the supervisor or the Training and Placement Officer (for purpose of examinations) to any faculty of the department.

Note on Elective Papers: The elective papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Note on Examination of Elective Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher and 75 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

(b) Papers with only practical component shall have 40 Marks continuous evaluation by the teacher and 60 Marks term-end examinations. Both these component marks shall be reflected on the marksheet of the student.

Note on Continuous Evaluation of All Papers:

(a) Papers with only theory component shall have 25 Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test*	- 15 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Assignments / Project / Quiz / Case Studies, etc.	- 5 Marks
iii.	Attendance / Class Participation	- 5 Marks

(b) Papers with only practical component shall have 40Marks continuous evaluation by the teacher which shall be evaluated as:

i.	Mid-Term Test and Viva Voce	- 20 Marks (after 8 weeks of teaching or as decided by PCC)
ii.	Practical File	- 10 Marks
iii.	Attendance / Lab Participation	- 10 Marks

***** The mid-term test shall be coordinated by the Programme Coordination Committee.***

If a student could not appear for a mid-term test due to situation beyond the control by the student, a supplementary test may be arranged towards the end of the semester, in a similar manner to the mid-term test for such students. The students must apply for this provision to the department / institution. On examination of the reason for non-appearing in the mid-term test by the Head of the Department / Institute, and with reason for allowing to appear in the supplementary test to recorded by the Head of the Department / Institute, the student may be allowed.

The attendance sheets, the question papers and the award sheets for the continuous evaluation to be retained by the concerned department / institute for at least 6 months after the declaration of the result by the Examination Division of the University.

Open Area Electives

Semester	Paper Code	OAE – 1 (Choose Any One)	L	P	Credits
6	ES-304	Real Time Operating Systems	4		4
6	ES-306T	Embedded System Architecture and Design	3		3
	ES-306P	Embedded System Architecture and Design Lab		2	1
6	FSD-320T	Web Development using MEAN Stack	3		3
	FSD-320P	Web Development using MEAN Stack Lab		2	1
6	FSD-322T	Web Development using MERN Stack	3		3
	FSD-322P	Web Development using MERN Stack Lab		2	1
6	OSD-330T	Programming in Windows Environment	3		3
	OSD-330P	Programming in Windows Environment Lab		2	1
6	OSD-334T	Android App Development	3		3
	OSD-334P	Android App Development Lab		2	1
6	IPCV-334T	Digital Image Processing	3		3
	IPCV-334P	Digital Image Processing Lab		2	1
6	OUHV-338	Understanding Human Being, Nature and Existence Comprehensively	4		4
6	OUHV-340	Vision for Humane Society	4		4
6	SE-350T	Software Measurements, Metrics and Modelling	3		3
	SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-352T	Service Oriented Architecture	3		3
	SE-352P	Service Oriented Architecture Lab		2	1
6	SE-354T	Software Project Management	3		3
	SE-354P	Software Project Management Lab		2	1
6		MOOCs (Swayam / NPTEL)			4
Semester	**Paper Code**	**OAE – 2 (Choose Any One)**	**L**	**P**	**Credits**
7	ES-403T	VHDL Programming	3		3
	ES-403P	VHDL Programming Lab		2	1
7	ES-405T	Real Time Embedded System Programming	3		3
	ES-405P	Real Time Embedded System Programming Lab		2	1
7	FSD-435T	PHP Programming and MySQL	3		3
	FSD-435P	PHP Programming and MySQL Lab		2	1
7	MAC-409T	Robotics Engineering	3		3
	MAC-409P	Robotics Engineering Lab		2	1
7	OECE-417T	Microprocessors and Interfacing	3		3
	OECE-417P	Microprocessors and Interfacing Lab		2	1
7	OECE-419T	Analog and Digital Communications	3		3
	OECE-419P	Analog and Digital Communications Lab		2	1
7	OECE-421T	Wireless Sensor Networks	3		3
	OECE-421P	Wireless Sensor Networks Lab		2	1
7	OSD-449T	Design Patterns	3		3
	OSD-449P	Design Patterns Lab		2	1
7	OSD-453T	Advanced Java Programming	3		3
	OSD-453P	Advanced Java Programming Lab		2	1
7	OSD-455T	Programming in Linux Environment	3		3
	OSD-455P	Programming in Linux Environment Lab		2	1
7	OUHV-463	Holistic Human Health	4		4
7	SC-479T	Global Optimization Methods	3		3
	SC-479P	Global Optimization Methods Lab		2	1
7	SE-487T	Software Verification, Validation and Testing	3		3
	SE-487P	Software Verification, Validation and Testing Lab		2	1
7		MOOCs (Swayam / NPTEL)			4

Note:

1. Each OAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of OAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required

2. The Open Area Electives described / enumerated are the one offered by engineering departments. If other departments, offering minor specialization or elective papers as open area electives to engineering students (approved by the university Academic Council) are possible at the concerned institution, the same may also be offered to the engineering students studying in the major disciplines under the aegis of the University School of Information, Communication and Technology. The APC of the department / intuition shall allow the choice of such electives, provided they follow the credit framework of the programme of study for open area electives.

Implementation Rules:

1. ***The examinations, attendance criteria to appear in examinations, promotion and award of the degree shall be governed by the Ordinance 11 of the University.*** The term “major discipline” / “primary discipline” in this document refers to the discipline in which student is admitted / studies from 3rd semester onwards. However credits of courses / paper for OAE / EAE groups shall not be considered for the purpose of promotion from one year of study to the subsequent year of study.

2. ***Minimum duration*** of the Bachelor of Technology programme shall be 4 years (N=4 years) (8 semesters) for the students admitted in the 1st year and 1st semester of the degree programme. Lateral entry students shall be admitted in the 2nd year and 3rd semester of the degree programme (effectively in the batch admitted in the first year in the previous academic session and shall be deemed to have been exempted from the courses / papers of the first year of the degree programme. No exemption certificate shall be issued in any case.

   A specific lateral entry students’ minimum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

3. ***Maximum duration of the Bachelor of Technology programme shall be 6 years (N+2 years).*** After completion of N+2 years of study, if the student has appeared in the papers of all the semesters upto 8th semester, then a maximum extension of 1 year may be given to the student for completing the requirements of the degree if and only if the number of credits already earned by the student is atleast 150 (for lateral entry students it shall be at least 102 credits) from the (non-honours components). Otherwise, the admission of the student shall stand cancelled. After the period of allowed study, the admission of the student shall be cancelled.

   A specific lateral entry students’ maximum duration shall be the same as the minimum duration for the batch in which he/she is admitted as a lateral entry student in the 2nd year.

4. ***The degree shall be awarded only after the fulfilment of all requirements of the Scheme and Syllabus of Examinations and the applicable Ordinance.***

5. (a) The students shall undergo the following group of Courses / Papers as enumerated in the scheme (***For the students admitted in the First Year / First Semester).***

Group	Semester (Credits)							Total Credits	Mandatory Credits
	I & II	III	IV	V	VI	VII	VIII		
BS	24		5					**29**	**14**
HS/MS	6	2	2	2	6	2		**20**	**10**
ES	20	5						**25**	**15**
PC		19	19	24	16	20	20	**118**	**104**
OAE					4	4		**8**	**4**
Total	**50**	**26**	**26**	**26**	**26**	**26**	**20**	**200**	**147**

TABLE 1: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 20 credits for Humanities / Management / Social Science Group (HS/MS)) . This table is for students admitted in the First Year / First Semester of the Degree Programme.

(b) The students admitted as Lateral Entry shall undergo the following group of Courses / Papers as enumerated in the scheme***.***

Group	Semester (Credits)						Total Credits	Mandatory Credits
	III	IV	V	VI	VII	VIII		
BS		5					**5**	**0**
HS/MS	2	2	2	6	2		**14**	**7**
ES	5						**5**	**0**
PC	19	19	24	16	20	20	**118**	**104**
OAE				4	4		**8**	**4**
Total	**26**	**26**	**26**	**26**	**26**	**20**	**150**	**115**

TABLE 2: Distribution of Credits (Project / Internship credits are 25 out the 118 credits for Programme Core (PC) credits, while extra-curricular activities credits are 2 out of 14 credits for Humanities / Management / Social Science Group (HS/MS)) This table is for students admitted as Lateral Entry Students in the Second Year / Third Semester of the Degree Programme.

6. Mandatory Credits specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree,for students admitted as students in the 1st year and 1st semester of the degree programme. While for students admitted as lateral entry in the 2nd year and 3rd semester the Mandatory Credits value is 115, and specify the number of credits from each subject group to be mandatorily acquired by the student for the award of the degree (Table 2). See clause 11 and 12 also**.**

7. Some of the papers are droppable in the sense that the student may qualify for the award of the degree even when the student has not cleared / passed some of the papers of these group. However, the student has to earn the minimum credits for the programme of study as specified. **See clause 11 and 12 also**.

8. The students may take 2 subjects from OAE group. The open electives of the OAE group of courses may also be taken through SWAYAM / NPTEL MOOCs platform. The student desirous of doing a MOOC based course among the OAE group must seek approval of the APC of the institute for the same before the commencement of the semester. The APC shall allow the MOOC based OAE option to the student if and only if the MOOC subject / course being considered for the student is being offered in line with the Academic Calendar applicable. The student shall submit the successful completion certificate with marks to the institution for onwards transfer to the Examination Division. The Examinations Division shall take these marks on record for incorporation in the result of the appropriate semester. These marks / grades of these courses shall be used for calculation of the SGPA/CGPA of the student concerned by the examination division of the University. The degree to the student on fulfilment of other requirements for such cases shall be through **clause 12.a. or 12.b.**

   These MOOC courses taken by the students, if allowed by the APC of the institute shall be of 4 credits or more collectively to be against or for one paper slot in the scheme, through MOOCs, though the marks shall be shown individually. That is in one paper slot in the scheme wherever a MOOC course is allowed, the student may register for more than one paper to aggregate 4 credits or more. **If the credits of these MOOC Courses, allowed to a student is more than 4, then the maximum credit for the programme shall be amended accordingly for the particular student.** Also, in a particular semester, a student may take more than one MOOC course with the approval of the APC to meet the credit requirements of OAE for the semester. The cost of taking the MOOC course is to be borne by the concerned student. The results of the MOOC courses shall be declared separately by the Examination Division from the result for the papers conducted by the examination division of the University.

   No minor specialization shall be offered / awarded.

9. To earn an Honours degree, the student may enrol for 20 credits or more through SWAYAM / NPTEL MOOCs platform. This point has to be read together with other points specially point 13 and 14. The

acquisition of the credits should be completed before the 15th of the July of the Admission Year plus 4 years. That is, if a student is admitted in the year X, then these credits must be acquired through MOOCs by 15th July of the year (X+4), no extra duration or time shall be allocated, this means, the student must submit the result of such papers on or before 15th July of the Admission Year plus 4 years.

Honours in the degree shall be awarded if and only if at least 20 credits are acquired through MOOCs. To obtain Honours in the programme, the student must apply to the institution about the same before the commencement of the 5th semester. The specific courses through MOOCs shall be registered by the student only after approval by the Academic Programme Committee (APC) of the Institute. The APC shall approve the course if it is not already studied by the student or the student shall not study it in future and adds value to the major area of specialization (which is the degree). The papers for which the student desires to appear for Honours through MOOCs, all papers results shall be submitted by the student to the Institute for onwards transfer to Examination Division of the University, to be taken on record of the University. The results of these papers shall be a part of the records of the examinations of the students. The records shall be submitted by the student to the Institute, then transferred to the Examination Division, shall be notified by the Examination Division of the University, and a separate marksheet shall be issued by the Examination Division. The cost of taking the MOOC course is to be borne by the concerned student. Such courses shall be reflected as additional courses / papers for the student.

If a student acquires less than 20 credits through MOOCs, following the mechanism specified, then also the results of these papers shall be taken on record as specified above, though no Honours degree shall be awarded.

The papers through MOOCs for Honours degree shall not be a part of the set of the papers over which the SGPA / CGPA of the student shall be calculated.

The papers through MOOCs for Honours degree shall be additional papers studied by the students and are to be taken into account only for award of Honours in the degree programme, if 20 credits are earned through MOOCs as approved by APC, by a student. **See Clause 13 also.**

10. Maximum Credits is at least 200 (Table 1) for students admitted in the 1st year and 1st semester, these are the credits for which the student shall have to study for the non-Honours component of the curriculum. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the maximum credit required to be studied is at least 150 (Table 2). **See clause 8 also**.

    The student has to appear in the examinations for these credits in all components of evaluation as specified in the scheme of studies.

11. Minimum Credits required to be earned is atleast 180 (out of the 200 non Honours papers credits, see clause 10 also) for students admitted in the 1st year and 1st semester. And, for lateral entry students admitted in the 2nd year and 3rd semester of the degree programme, the minimum credit required to be earned Is at least 135 (out of the 150 non Honours papers credits, see clause 10 also). See clause 6 also.

12. The following degree route can be taken by a student **(also refer point 13)**:

    a. The students shall be awarded the degree without any minor specialization under the following conditions:

        i. The student has earned the mandatory credits as defined in **Table 1** or **Table 2** (as applicable) and **clause 6**.

        ii. In addition, the total credits (including the above specified credits) earned by the student is atleast as specified in **clause 11**.

        The degree nomenclature of the degree shall be as: "***Bachelor of Technology in Computer Science and Engineering (Cyber Security)";*** if criteria / **point 9** is not satisfied for Honours. Otherwise, if criteria / **point 9** is met, then the degrees shall be an Honours degree and the nomenclature shall be as: "***Bachelor of Technology in Computer Science and Engineering (Cyber Security) (Honours)***", if in addition to **point 12.b.i and 12.b.ii**, the student fulfils the criteria for Honours as specified at **point 9**.

    b. If the student does not fulfil any of the above criterions (**point 12.a, or 12.b**), if the student earns at least the minimum credits specified in clause 11 (disregarding the mandatory credits clause of **Table 1**

or Table 2 (as applicable) and **Clause 6**), then the student shall be award the degree as "***Bachelor of Technology in Computer Science and Engineering (Cyber Security)".*** Such students shall not be eligible for the award of an Honours degree. Though, if credits are accumulated through MOOCs as per **clause 9**, the same shall be reflected in the marksheets of the students.

13. ***The Honours degree shall only be awarded if the CGPA of the student is above or equal to 7.5 in addition to fulfilment of criteria / point 10 and 13 above and the degree is awarded after the immediate completion of the 4th year of the batch from the year of admission.*** No Honours shall be conferred if the degree requirements are not completed in the minimum duration.
14. ***Pass marks in every paper shall be 40.***
15. ***Grading System shall be as per Ordinance 11 of the University.***
16. The institution shall offer atleast two elective groups out of the open area for students of each major discipline. The institute shall decide the group(s) and/or individual papers to be offered as electives based on the availability of infrastructure and faculty. From the groups / papers offered by the institute, an elective paper / group shall be taught if and only if the number of students in a paper is at-least 20 or at-least 1/3 of the students of a major discipline for which the paper / group is to be offered. The APC of the department / institute may define a maximum number of students allowed to register for a paper as an open area elective.
17. Teachers of the other department(s), as and when deputed by their department, for teaching the students enrolled in programmes offered by the department offering the programme shall be a part of the Academic Programme Committee of the discipline. Such teachers, for all academic matters, including teaching, teachers' continuous evaluation, term end examinations etc. shall be governed by the decisions of the APC of department offering the programme of study. Similarly, the guest faculty, the visiting faculty and the Contract / Ad Hoc faculty as and when deputed to teach students of a particular department shall form a part of APC of the department.
18. The Paper IDs will be generated / issued / assigned by the Examination Division of the University.
19. **The medium of instructions shall be English.**

Assessment of Outcomes Achieved in a Course / Paper. That is, Learning Outcome Assessment Alignment Grid.

Learning Outcome	Course/Project	How Learning Will Be Assessed	Resources	Attainment Level

To complete the alignment grid, start by listing one learning outcome per row beneath the "Learning Outcome" column. Make sure that each learning outcome can be assessed by a single method.

Next, beneath the "Course/ Project" column, list the course(s) or project(s) or assignments or tests that students will complete in order to achieve the learning outcome.

In the "How Learning Will Be Assessed" column, list the assessment(s) tool that will be used for that particular learning outcome. It is fine for there to be more than one assessment used for a particular outcome, so long as each assessment captures the outcome in its entirety. Likewise, it is fine for a single assessment to be used for multiple outcomes.

In the column entitled "Resources", list any additional materials, technologies, or resources needed for students to meet the learning outcome.

In the column entitled "Attainment Level", list in a quantifiable manner the average attainment level.

Every teacher must make this sheet for every paper taught. Be that a paper with only theory component, only practical component or with both theory and practical component.

Syllabus of 2nd Year Papers

(3rd Semester for Lateral Entry Students only)

Paper Code(s): BC-181	L / P
Paper: Bridge Course in Mathematics	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is NUES, non-credit and qualifying Paper. All examinations to be conducted by the concerned teacher.

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand the limits, differentiation and integration.
2:	To understand differential equations.
3:	To understand the concepts of matrices.
4:	To understand the concept of vectors and to find out Eigen values.

Course Outcomes (CO):

CO1	Ability to understand the use of limits, differentiation and integration.
CO2	Ability to understand and apply the ordinary differential equations.
CO3	Ability to use matrices to solve linear equations.
CO4	Ability to understand linear independence and dependence of vectors.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I
Differentiation: Limits, Definition, Formulas, Differentiation Rules, Real life applications of Differentiation
Integration: Definition, Indefinite Integral, Integration formulas, Definite Integral and its properties,
Real life applications of Integration
Unit II
Ordinary Differential Equations: Definition, Solution of ordinary differential equation, linear differential equation of first order, initial value problem, linear differential equation of higher order with constant coefficients
Unit III
Matrices-I: Definition of Matrix and Determinant, Type of Matrices, Properties of Determinants, Transpose of a matrix, Inverse of a matrix, Solution of system of linear equations using the inverse of a matrix, Rank of a matrix.
Unit IV
Matrices-II: Vectors, Linear independence and dependence of vectors; Eigen values and Eigen vectors or matrix.
Textbooks:
1. *Higher Engineering Mathematics* by B S Grewal, Khanna Publishing.

References:
1. *Advanced Engineering Mathematics* by Erwin Kreyszig, John Wiley, 10th Ed., 2011.

Paper Code(s): BC-183	L / P
Paper: Bridge Course in Programming in C	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is NUES, non-credit and qualifying Paper. All examinations to be conducted by the concerned teacher.

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To impart basic knowledge about simple algorithms for arithmetic and logical problems so that students can understand how to write a program, syntax and logical errors in ‘C’.
2:	To impart knowledge about how to implement conditional branching, iteration and recursion in ‘C’.
3:	To impart knowledge about using arrays, pointers and structures to develop programs in ‘C’.
4:	To impart knowledge about using structures, unions and strings to develop programs in ‘C’.

Course Outcomes (CO):

CO1	Ability to write simple programs in in ‘C’.
CO2	Ability to implement conditional branching, iteration and arrays in ‘C’
CO3	Ability to implement functions and pointers in ‘C’
CO4	Ability to use structures, unions and strings in the programs in ‘C’.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	2	1	1	3
CO2	3	3	2	1	1	-	-	-	2	1	1	3
CO3	3	3	3	1	1	-	-	-	2	1	1	3
CO4	3	3	3	1	1	-	-	-	2	1	1	3

Unit I

Introduction to Programming: Creating and running programs, Preprocessor, Compilation process, role of linker, idea of invocation and execution of a programme.

Introduction to C language: Basic structure of C programs, C tokens, variables, data types, I/O statements. Inter-conversion of variables.

Operators and expressions: Operators, arithmetic, relational and logical, assignment operators, increment and decrement operators operator precedence and associativity, evaluation of expressions, type conversions in expressions.

Unit II

Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, jump statements, break, continue, goto statements.

Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays.

Unit III

Functions: User defined and built-in Functions, storage classes, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion.

Pointers: Pointer basics, pointer arithmetic, functions returning pointers, Dynamic memory allocation. Pointers and Strings.

Unit IV

Structures and unions: Structure definition, initialization, accessing structures, structures and functions, self-referential structures, unions, typedef.

Strings: Arrays of characters, variable length character strings, inputting character strings, character library function.

Textbooks:

1. *The C programming language* by B W Kernighan and D M Ritchie, Pearson Education, 1988.

References:

1. *Engineering Problem Solving With C* by Delores M. Etter, Pearson, 2013.
2. *Problem Solving and Program Design in C* by Jeri R. Hanly and Elliot B. Koffman, Pearson, 2016.
3. *ANSI/ISO 9899-1990, American National Standard for Programming Languages 'C'* by American National Standards Institute, Information Technology Industry Council, 1990 (C89).

Syllabus of 2nd Year Papers

Paper Code(s): ES-201	L	P	C
Paper: Computational Methods	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand numerical methods to find roots of functions and first order unconstrained minimization of functions.
2.	To introduce concept of interpolation methods and numerical integration.
3.	To understand numerical methods to solve systems of algebraic equations and curve fitting by splines.
4.	To understand numerical methods for the solution of Ordinary and partial differential equations.

Course Outcomes (CO)

CO 1	Ability to develop mathematical models of low level engineering problems
CO 2	Ability to apply interpolation methods and numerical integration.
CO 3	Ability to solve simultaneous linear equations and curve fitting by splines
CO 4	Ability to numerically solve ordinary differential equations that are initial value or boundary value problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT-I

Review of Taylor Series, Rolle 's Theorem and Mean Value Theorem, Approximations and Errors in numerical computations, Data representation and computer arithmetic, Loss of significance in computation
Location of roots of equation: Bisection method (convergence analysis and implementation), Newton Method (convergence analysis and implementation), Secant Method (convergence analysis and implementation). Unconstrained one variable function minimization by Fibonacci search, Golden Section Search and Newton's method. Multivariate function minimization by the method of steepest descent, Nelder- Mead Algorithm.

UNIT-II

Interpolation: Assumptions for interpolation, errors in polynomial interpolation, Finite differences, Gregory-Newton's Forward Interpolation, Gregory-Newton's backward Interpolation, Lagrange's Interpolation, Newton's divided difference interpolation
Numerical Integration: Definite Integral, Newton-Cote's Quadrature formula, Trapezoidal Rule, Simpson's one-third rule, simpson's three-eight rule, Errors in quadrature formulae, Romberg's Algorithm, Gaussian Quadrature formula.

UNIT-III

System of Linear Algebraic Equations: Existence of solution, Gauss elimination method and its computational effort, concept of Pivoting, Gauss Jordan method and its computational effort, Triangular Matrix factorization methods: Dolittle algorithm, Crout's Algorithm, Cholesky method, Eigen value problem: Power method
Approximation by Spline Function: First-Degree and second degree Splines, Natural Cubic Splines, B Splines, Interpolation and Approximation

UNIT - IV

Numerical solution of ordinary Differential Equations: Picard's method, Taylor series method, Euler's and Runge-Kutta's methods, Predictor-corrector methods: Euler's method, Adams-Bashforth method, Milne's method.
Numerical Solution of Partial Differential equations: Parabolic, Hyperbolic, and elliptic equations
Implementation to be done in C/C++

Textbook(s):
1. E. Ward Cheney & David R. Kincaid , "Numerical Mathematics and Computing" Cengage; 7th ed (2013).

References:
1. R. L. Burden and J. D. Faires, "Numerical Analysis", CENGAGE Learning Custom Publishing; 10^{th} Edition (2015).
2. S. D. Conte and C. de Boor, "Elementary Numerical Analysis: An Algorithmic Approach", McGraw Hill, 3rd ed. (2005).
3. H. M. Antia, "Numerical Methods for Scientists & Engineers", Hindustan Book Agency, (2002).
4. E Balagurusamy "Numerical Methods" McGraw Hill Education (2017).

Paper Code(s): HS-203	L	P	C
Paper: Indian Knowledge System	**2**	**-**	**2**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the Indian knowledge System.
2.	To understand the foundational concepts for science and technology.
3.	To understand the ancient Indian mathematics and astronomy.
4.	To understand the ancient Indian engineering and technology.

Course Outcomes (CO)

CO 1	Ability to understand the Indian knowledge System.
CO 2	Ability to understand and apply foundational concepts for science and technology.
CO 3	Ability to understand and apply ancient Indian mathematics and astronomy
CO 4	Ability to understand ancient Indian engineering and technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	-	-	-	-	2
CO 2	-	-	-	-	-	3	-	-	-	2	-	2
CO 3	3	3	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	-	-	-	-	-	-	-	-	-	2

UNIT-I

Indian Knowledge System (IKS) - An Introduction:
Overview of IKS - Importance of Ancient Knowledge; Defining IKS; The IKS Corpus – A Classification Framework; Chaturdaśa-Vidyāsthāna; History of IKS, Some unique aspects of IKS;
The Vedic Corpus – Introduction to Vedas; The Four Vedas and their divisions; Vedāngas; Vedic Life;
Philosophical Systems – Indian Philosophical Systems; Vedic Schools of Philosophy; Non-Vedic Philosophical Systems; Wisdom through the Ages – Purānas, Itihāsa as source of wisdom, Rāmāyana, Mahābhārata, Niti-śāstras, Subhāssitas.

UNIT-II

Foundational Concepts for Science and Technology:
Linguistics - Components of Language; Pānini's work on Sanskrit Grammar; Phonetics in Sanskrit; Patterns in Sanskrit Vocabulary; Computational Concepts in Astādhyāyi, Logic for Sentence Construction; Importance of Verbs; Role of Sanskrit in Natural Language Processing
Number System and Units of Measurement – Number System in India; Salient Features of the Indian Numeral System; Unique approaches to represent numbers; Measurements for Time, Distance and Weight; Pingala and

the Binary System
Knowledge: Framework and Classification – The Knowledge Triangle; Prameya; Pramāna; Samśaya; Framework for establishing Valid Knowledge

UNIT-III

Mathematic and Astronomy in IKS:
Mathematics – Unique aspects of Indian Mathematics; Great Mathematicians and their Contributions; Arithmetic; Geometry; Trigonometry; Algebra; Binary Mathematics and Combinatorial Problems in Chandah-śāstra of Pingala, Magic Squares in India
Astronomy - Unique aspects of Indian Astronomy; Historical Development of Astronomy in India; The Celestial Coordinate System; Elements of the Indian Calendar; Āryabhatiya and the Siddhāntic Tradition; Pancānga; Astronomical Instruments; Jantar Mantar of Rājā Jai Singh Sawai

UNIT - IV

Engineering and Technology in IKS:
Engineering and Technology: Metals and Metalworking – The Indian S & T Heritage; Mining and Ore Extraction; Metals and Metalworking Technology; Iron and Steel in India; Lost wax casting of Idols and Artefacts; Apparatuses used for Extraction of Metallic Components
Engineering and Technology: Other Applications – Literary sources for Science and Technology; Physical Structures in India; Irrigation and Water Management; Dyes and Painting Technology; Surgical Techniques; Shipbuilding; Sixty-four Art Forums; Status of Indigenous S & T

Textbook(s):
1. B. Mahadevan, Vinayaka Rajat Bhat & Nagendra Pavana R.N., “Introduction to Knowledge System: Concepts and Applications” PHI (2022).

References:
1. C.M Neelakandhan & K.A. Ravindran, “Vedic Texts and The Knowledge Systems of India”, Sri Sankaracharya University of Sanskrit, Kalady (2010).
2. P.P. Divakaran, “The Mathematics of India: Concepts, Methods, Connections”, Springer (2018)
3. C.A. Sharma, “Critical Survey of Indian Philosophy”, Motilal Banarasidass Publication (1964)
4. G. Huet, A. Kulkarni & P. Scharf, “Sanskrit Computational Linguistics”, Springer (2009).
5. A.K. Bag, “History of Technology in India”, Indian National Science Academy, Vol 1, (1997)

Paper Code(s): CIC-205	L	P	C
Paper: Discrete Mathematics	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concept of Mathematical Logic, concepts of sets, relation and functions
2.	To introduce the concept of Algorithm and number theory
3.	To understand Group theory and related examples
4.	To use Graph theory for solving problems

Course Outcomes (CO)

CO1:	Ability for constructing mathematical logic to solve problems
CO2:	Ability to Analyze/ quantify the efficiency of a developed solution (algorithm) of a computational problem
CO3:	Ability to Understand mathematical preliminaries to be used in the subsequent courses of the curriculum. This includes Boolean algebra, number theory, group theory, and combinatorics.
CO4:	Ability to Understand diverse relevant topics in discrete mathematics and computation theory with an emphasis on their applicability as mathematical tools in computer science.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	-	-	-	2	2	3	3
CO 2	3	3	3	2	2	-	-	-	2	2	3	3
CO 3	3	3	3	3	2	-	-	-	2	2	3	3
CO 4	3	3	3	3	2	-	-	-	2	2	3	3

UNIT – I

Sets, Logic, and Relation: Sets, Subsets, powerset, operations on sets, Propositional Logic, Rules of inferences in propositional logic, Quantifiers, Predicates and validity, Predicate Logic, normal forms. Proof Techniques- Direct Proof, Proof by Contraposition, and proof by contradiction. Principle of inclusion and exclusion, pigeonhole principle, permutation and combination. Principle of Well Ordering, principle of mathematical induction, principle of complete induction. Relation, properties of binary relation, equivalence relation and class, closures (symmetric, reflexive, and transitive).

UNIT – II

Functions, Order relations and Boolean Algebra: Functions, Growth of functions, Permutation functions, Partially ordered sets, lattices, Boolean algebra, Minimization of Boolean Expressions. GCD, LCM, prime numbers.
Recurrence relations, solution methods for linear, first-order recurrence relations with constant coefficients, generating functions, Analysis of Algorithms involving recurrence relations, solution method for a divide-and-

conquer recurrence relation. Masters theorem (with proof).

UNIT – III

Group theory: Semi-group, Monoid, Groups, Group identity and uniqueness, inverse and its uniqueness, isomorphism and homomorphism, subgroups, Cosets and Lagrange's theorem, Permutation group and Cayley's theorem (without proof), Normal subgroup and quotient groups. Groups and Coding.

UNIT – IV

Graph theory: Graph Terminology, Planar graphs, Euler's formula (proof), Euler and Hamiltonian path/circuit. Chromatic number of a graph, five color theorem (proof), Shortest path and minimal spanning trees and algorithms, Depth-first and breadth first search, trees associated with DFS & BFS, Connected components. Complexity Analysis of the graph MST.

Textbook(s):
1. B. Kolman, R. C. Busby & S.C. Ross "Discrete Mathematical Structures", 6th edition, PHI/Pearson, 2009.
2. R. L. Graham, D. E. Knuth & O. Patashnik, "Concrete Mathematics", Pearson Education, 2000.

References:
1. Neal Koblitz, "A course in number theory and cryptography", Springer – Verlag, 1994.
2. J.P. Tremblay & R. Manohar, "Discrete Mathematical Structure with Application to Computer Science," TMH, New Delhi (2000).
3. Norman L. Biggs, "Discrete Mathematics", Second edition, Oxford University Press, New Delhi (2002).
4. T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd edition, PHI/Pearson.
5. Anne Benoit, Yves Robert, Frédéric Vivien "A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis", CRC Press, 2013.

Paper Code(s): ECC-207	L	P	C
Paper: Digital Logic and Computer Design	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts of Boolean Algebra and Combinational Logic
2.	To introduce various sequential circuits, designing with examples
3.	To relate combination circuit design and sequential circuit design with respect to the design of a computer system
4.	To introduce machine learning, computer arithmetic, modes of data transfer with respect to I/O and Memory organization of a computer

Course Outcomes (CO) :

CO 1	Ability to understand Boolean Algebra and Design Combinational Circuits .
CO 2	Ability to understand and Design Sequential Circuits.
CO 3	Ability to understand Design of a basic computer.
CO 4	Ability to understand Input-Output and Memory Organization of a Computer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT – I

Boolean Algebra and Combinational Logic: Review of number systems , signed, unsigned, fixed point, floating point numbers, Binary Codes, Boolean algebra – basic postulates, theorems , Simplification of Boolean function using Karnaugh map and Quine-McCluskey method – Implementations of combinational logic functions using gates, Adders, Subtractors, Magnitude comparator, encoder and decoders, multiplexers, code converters , parity generator/checker, implementation of combinational circuits using multiplexers.

UNIT – II

Sequential Circuits: General model of sequential circuits, Flip-flops, latches , level triggering, edge triggering, master slave configuration , concept of state diagram , state table, state reduction procedures , Design of synchronous sequential circuits , up/down and modulus counters , shift registers, Ring counter , Johnson counter , timing diagram , serial adder , sequence detector, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Memory Unit, Random Access Memory

UNIT – III

Basic Computer organization: Stored Program, Organization, Computer registers, bus system, instruction set completeness, instruction cycle, Register Transfer Language, Arithmetic, Logic and Shift Micro-operations, Instruction Codes, Design of a simple computer, Design of Arithmetic Logic unit, shifter, Design of a simple hardwired control unit, Programming the basic computer, Machine language instructions, assembly language, Microprogrammed control, Horizontal and Vertical Microprogramming, Central Processing Unit, instruction sets and formats, addressing modes, data paths, RISC and CISC characteristics.

UNIT – IV

Computer Arithmetic, addition, subtraction, multiplication and division algorithms, Input-Output Organization, Modes of data transfer, Interrupt cycle, direct memory access, Input-Output processor, Memory Organization, Memory Hierarchy, Associative Memory, Cache Memory, Internal and external Memory, Virtual Memory.

Text Book(s)

1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016
2. M. Morris Mano, Rajib Mall "Computer System Architecture", 3rd Edition Pearson Education, 2017

References:

1. Leach, D. P., Albert P. Malvino, "Digital Principles and Applications", McGraw Hill Education, 8th Edition , 2014
2. Jain, R.P. ,"Modern Digital Electronics", McGraw Hill Education, 4th Edition , 2010
3. Floyd, Thomas L. , "Digital Fundamentals" Pearson Education, 11th Edition, 2017
4. M. Rafiquzzaman, "Fundamentals of Digital Logic and Microcomputer Design", Wiley, 5th Ed., 2005.

Paper Code(s): CIC-209	L	P	C
Paper: Data Structures	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basics of Data structures (Arrays, strings, linked list etc.)
2.	To understand the concepts of Stacks, Queues and Trees, related operations and their implementation
3.	To understand sets, heaps and graphs
4.	To introduce various Sorting and searching Algorithms

Course Outcomes (CO)

CO 1	To be able to understand difference between structured data and data structure
CO 2	To be able to create common basic data structures and trees
CO 3	To have a knowledge of sets, heaps and graphs
CO 4	To have basic knowledge of sorting and searching algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	2	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	2	2	2	3

UNIT – I

Overview of data structure, Basics of Algorithm Analysis including Running Time Calculations, Abstract Data Types, Arrays, Arrays and Pointers, Multidimensional Array, String processing, General Lists and List ADT, List manipulations, Single, double and circular lists. Stacks and Stack ADT, Stack Manipulation, Prefix, infix and postfix expressions, recursion. Queues and Queue ADT, Queue manipulation.

UNIT – II

Sparse Matrix Representation (Array and Link List representation) and arithmetic (addition, subtraction and multiplication), polynomials and polynomial arithmetic.
Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, Expression trees and their usage, binary search trees, AVL Trees, Heaps and their implementation, Priority Queues, B-Trees, B* Tree, B+ Tree

UNIT – III

Sorting concept, order, stability, Selection sorts (straight, heap), insertion sort (Straight Insertion, Shell sort), Exchange Sort (Bubble, quicksort), Merge sort (External Sorting) (Natural merge, balanced merge and polyphase merge). Searching – List search, sequential search, binary search, hashing methods, collision resolution in hashing.

UNIT – IV

Disjoint sets representation, union find algorithm, Graphs, Graph representation, Graph Traversals and their implementations (BFS and DFS). Minimum Spanning Tree algorithms, Shortest Path Algorithms

Textbook(s):

1. Richard Gilberg , Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning, Oct 2004
2. E. Horowitz, S. Sahni, S. Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Silicon Press (US), 2007.

References:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson, September, 1996
2. Robert Kruse, “Data Structures and Program Design in C”, 2nd Edition, Pearson, November, 1990
3. Seymour Lipschutz, “Data Structures with C (Schaum's Outline Series)”, McGrawhill, 2017
4. A. M. Tenenbaum, “Data structures using C”. Pearson Education, India, 1st Edition 2003.
5. Weiss M.A., “Data structures and algorithm analysis in C++”, Pearson Education, 2014.

Paper Code(s): CIC-211	L	P	C
Paper: Object-Oriented Programming Using C++	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic Concepts of Object Oriented Programming (data types, operators and functions) using C++
2.	To introduce concepts of Classes and Objects with the examples of C++ programming
3.	To understand object oriented features such as Inheritance and Polymorphism
4.	To use various object oriented concepts (exceptional handling) to solve different problems

Course Outcomes (CO)

CO 1	Ability to have an in-depth knowledge of object oriented programming paradigm
CO 2	To be able to develop basic C++ programming skills
CO 3	To be able to apply various object oriented features using C++
CO 4	Ability to have an understanding of generic programming & standard templates

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT – I

Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented Languages, Applications of Object Oriented Programming, C++ Programming Language, Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++, Implicit Type Conversions, Operator Precedence, The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend Functions, default parameter value.

UNIT – II

Specifying a class, Member Functions, Encapsulation, information hiding, abstract data types, objects & classes, Static Member Functions, Arrays of Objects, Constructors & Destructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, identity and behaviour of an object, C++ garbage collection, dynamic memory allocation, Explicit Type Conversions, Operator Overloading.

UNIT – III

Inheritance, inheritance methods, Class hierarchy, derivation – public, private & protected, aggregation, Inheritance Constructors, composition vs. classification hierarchies, Containership, Initialization List, Polymorphism, categorization of polymorphic techniques, polymorphism by parameter, parametric polymorphism, generic function – template function, function overriding, run time polymorphism, virtual functions.

UNIT – IV

Standard C++ classes, using multiple inheritance, persistant objects, streams and files, namespaces, exception handling, generic classes, standard template library: Library organization and containers, standard containers, algorithm and Function objects, iterators and allocators, strings, streams, manipulators, user defined manipulators, vectors.

Textbook(s):

1. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo, “C++ Primer”, Addison-Wesley Professional, 2012.
2. Ivor Horton, “Using the C++ Standard Template Libraries”, Apress, 2015.
3. R. Lafore, “Object Oriented Programming using C++”, Galgotia.

References:

1. A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH
2. Bjarne Stroustrup, “Programming: principles and practice using C++”, Addison-Wesley, 2015.
3. Bjarne Stroustrup, “A Tour of C++”, Addison-Wesley Professional, 2018.
4. Bjarne Stroustrup, “The C++ Programming Language”, 4th Edition, Addison-Wesley Professional, 2013.
5. Peter Van Weert and Marc Gregoire, “C++17 Standard Library Quick Reference: A Pocket Guide to Data Structures, Algorithms, and Functions”, Apress (2019)
6. Rumbaugh et. al. “ Object Oriented Modelling & Design”, Prentice Hall
7. G . Booch “Object Oriented Design & Applications”, Benjamin,Cummings.
8. E.Balaguruswamy, “Objected Oriented Programming with C++”, TMH
9. Steven C. Lawlor, “The Art of Programming Computer Science with C++”, Vikas Publication.
10. Slobodan Dmitrović, Modern C++ for Absolute Beginners”:A Friendly Introduction to C++ Programming Language and C++11 to C++20 Standards”, Apress, 2020.

Paper Code(s): ECC-205	L	P	C
Paper: Signals and Systems	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To impart understanding about various types of signals and systems, their classifications, analysis and operations.
2.	To impart knowledge of use of transforms in analysis of signals and system.
3.	To impart skill to carry out simulation on signals and systems for observing effects of applying various properties and operations.
4.	To impart strong foundation of communication and signal processing to be studied in the subsequent semester

Course Outcome (CO):

CO 1	Ability to understand about various types of signals and systems, classify them, analyze them, and perform various operations on them.
CO 2	Ability to understand use of transforms in analysis of signals and system.
CO 3	Ability to carry out simulation on signals and systems for observing effects of applying various properties and operations.
CO 4	Ability to create strong foundation of communication and signal processing to be studied in the subsequently.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	-	-	-	1	1	1	1
CO 2	3	3	3	3	2	-	-	-	1	1	1	1
CO 3	3	3	3	3	2	-	-	-	1	1	1	1
CO 4	3	3	3	3	2	-	-	-	1	1	1	1

Unit I

Continuous and discrete time signals: Classification of Signals – Periodic aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity – properties of discrete time complex exponential unit impulse – unit step impulse functions – Transformation in independent variable of signals: time scaling, time shifting. Determination of Fourier series representation of continuous time and discrete time periodic signals – Explanation of properties of continuous time and discrete time Fourier series. Representation of continuous time signals by its sample - Sampling theorem – Reconstruction of a Signal from its samples, aliasing – discrete time processing of continuous time signals, sampling of band pass signals.

Unit II

Continuous time Fourier Transform and Laplace Transform analysis with examples – properties of the Continuous-time Fourier Transform and Laplace Transform basic properties, Parseval's relation, and convolution in time and frequency domains.
Basic properties of continuous time systems: Linearity, Causality, time invariance, stability, magnitude and Phase representations of frequency response of LTI systems -Analysis and characterization of LTI systems using Differential Equations and Continuous time LTI systems. Laplace transform: Computation of impulse response and transfer function using Laplace transform.

Unit III

Discrete time system analysis using Difference equations, Discrete Time Fourier Transform, Discrete Fourier Transform, FFT and their property and usage in the analysis of Discrete time systems.

Unit IV

Basic principles of z-transform - z-transform definition – region of convergence – properties of ROC – Properties of z-transform – Poles and Zeros – inverse z-transform using Contour integration - Residue Theorem, Power Series expansion and Partial fraction expansion, Relationship between z-transform and Fourier transform. Properties of convolution and the interconnection of LTI Systems – Causality and stability of LTI Systems. Computation of Impulse & response & Transfer function using Z Transform.

Textbook(s):

1. Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab, "Signals & Systems", 2nd ed., Pearson Education, 1997.
2. Simon Haykin and Barry Van Veen, "Signals and Systems", John Wiley, 1999

References:

1. M. J. Roberts, "Signals and Systems Analysis using Transform method and MATLAB", TMH 2003.
2. K. Lindner, "Signals and Systems", McGraw Hill International, 1999.
3. Moman .H. Hays," Digital Signal Processing ", Schaum's outlines, Tata McGraw-Hill Co Ltd., 2004.
4. B. P. Lathi, "Signal Processing and Linear System", Berkeley Cambridge Press, 1998.
5. H. P. Hsu, "Schaum's Outlines of The Theory and Problems of Signals and Systems", McGraw-Hill, 1995.
6. John G.Proakis and Dimitris G.Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications, 3rd edn., PHI, 2000.

Paper Code(s): ECC-209	L	P	C
Paper: Analog Communication	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To impart understanding of the concepts of analog communication systems.
2.	To impart understanding of various modulation and demodulation techniques of analog communication.
3.	To impart understanding of transmitters and receivers in analog communication.
4.	To impart understanding of the causes of noise and noise performance of analog communication.

Course Outcome (CO):

CO 1	To understand the concepts of analog communication systems.
CO 2	To understand various modulation and demodulation techniques of analog communication.
CO 3	To understand transmitters and receivers in analog communication.
CO 4	To understand the causes of noise and noise performance of analog communication.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

The Communication Process, Review of Fourier Transforms and Dirac Delta Functions, Transmission through Linear Systems, Filters (low pass and band pass signals), Phase and Group Delay, Sources of Information.
Amplitude Modulation: Introduction, Double Sideband – Suppressed Carrier Modulation, Quadrature – Carrier Multiplexing, Single-Sideband and Vestigial-Sideband methods of modulation, Frequency Translation, Frequency-Division Multiplexing

UNIT II

Angle Modulation: Introduction, Basic Definitions, Frequency Modulation, Phase-Locked Loop, Nonlinear Effects in FM Systems, Superheterodyne receiver.

UNIT III

Probability and Random Processes: Introduction; Probability; Random Variables, Statistical Averages; Random Processes; Mean, Correlation, and Covariance functions; Transmission of a Random Process Through a Linear Filter, Power Spectral Density, Gaussian Process, Noise, Narrowband Noise

UNIT IV

Noise: Introduction, Receiver Model, Noise in DSB-SC Receivers, Noise in AM Receivers, Noise in FM Receivers, Pre-emphasis and De-emphasis in FM.

Textbook(s):

1. Simon Haykins and Michael Moher, "Communication Systems" John Wiley &sons Inc, 5th edition, 2009.

References:

1. B P Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", OUP, 5th edition, 2019.
2. H. Taub, D. L. Schilling and Gaotam Saha, "Taub's Principles of Communication Systems", McGraw Hill Eduction, 4th edition, 2017.
3. J. G. Proakis, M. Salehi, "Fundamentals of Communications Systems", Pearson, 2nd Edition, 2014.
4. W. Tomasi, "Electronic communications systems (Fundamentals Through Advanced)", Pearson Education, 5th Edition, 2008.
5. G. Kennedy and B. Davis, "Electronic communication systems", TMH, 4th Edition, 2008 (reprint)

Paper Code(s): ECC-211	L	P	C
Paper: Analog Electronics – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To develop understanding of operation, characteristics, parameters and applications of p-n junction diode
2.	To develop understanding about BJT and FET in terms of structure, operation, configurations and characteristics. Also analyse stability and amplifier circuit using small signal models
3.	To impart knowledge of cascade amplifiers, coupling schemes, power amplifiers and their analysis
4.	To impart knowledge of Feedback amplifiers and oscillators

Course Outcome (CO):

CO 1	Ability to understand of operation, characteristics, parameters and applications of p-n junction diode
CO 2	Ability to understand about BJT and FET in terms of structure, operation, configurations and characteristics and able to analyse stability and amplifier circuit using small signal models
CO 3	Ability to understand and analyse cascade amplifiers, coupling schemes in amplifiers and power amplifiers
CO 4	Ability to understand feedback amplifiers and oscillators

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

Open circuit P-N junction diode, Forward and reverse biased diode, I-V characteristics of diode, Diode Equation, Temperature dependence of diode. Breakdown phenomena, diffusion and transition capacitance of diode. Diode equivalent circuit, Ideal diode. Solar cell.
Diode circuits: half-wave and full-wave rectifiers with capacitor filter, clamping and clipping circuits. Zener diodes as voltage regulator.

UNIT – II

Bipolar Junction transistor (BJT): Structure, modes of operation, Configurations, I-V characteristics, early effect, junction voltages; Transistor Biasing: Need of biasing, load line concept, fixed bias, self-bias, collector to base bias, stability factors, Current Mirrors; hybrid model of BJT amplifier, small signal analysis of CE BJT amplifier using h parameter
JFET: Physical structure, I-V characteristics; MOSFET: Depletion and enhancement types, Physical structure and I-V characteristics; FET small-signal model (low & high frequency); MOSFET as resistance and switch,

UNIT – III

Cascade amplifiers: Analysis of cascade amplifier (voltage gain, current gain, input and output impedances); Darlington pair, Cascode amplifier; Types of coupling: DC, RC and Transformer; RC coupled Amplifier and its frequency response; Differential Amplifier: differential and Common mode operation, CMRR.
Power Amplifiers: Classification of output stages (Class A, B, C & AB), Class A Amplifier, Transformer coupled class A amplifier, Push pull amplifiers: Class A and Class B, Harmonic distortion, efficiency, crossover distortion, class AB operation, Class C amplifier.

UNIT – IV

Feedback Amplifiers: classification, Feedback concept, basic feedback topologies, Characteristics of Negative Feedback, Feedback and stability, gain margin, Noise margin,
Sinusoidal Oscillator, Barkhausen criterion, RC phase shift, LC (Colpitt's, Hartley, Clapp), Crystal Oscillator.

Textbook(s):

1. J. Millman, C.C. Halkias and Satyabrata Jit, "Electronic Devices and Circuits", Tata McGraw Hill, 4th ed. , 1998
2. R. L. Boylestad and N. Nashlesky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Ed., 2014

References:

1. Adel S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits Theory and Applications," 5th Edition , OUP, 2004.
2. B. Kumar and S. B. Jain, "Electronic Devices and Circuits"", Prentice Hall of India, 2007
3. S Salivahanan, and N. Suresh Kumar, "Electronic Devices and Circuits", McGraw Hill Education (India), 2018
4. B.P. Singh and Rekha Singh, "Electronic Devices and Integrated Circuits", Pearson Education, 2009.
5. J. J. Cathey, "Schaum's Outline of Theory and Problems in Electronic Devices and Circuits", McGraw Hill, 2002.

Paper Code(s): EEC-209	L	P	C
Paper: Electrical Materials	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of conducting materials.
2.	To impart the knowledge of insulating materials.
3.	To impart the knowledge of magnetic materials.
4.	To impart the knowledge of special materials.

Course Outcomes (CO)

CO 1	Ability to understand properties and applications of conducting materials.
CO 2	Ability to understand properties and applications of insulating materials.
CO 3	Ability to understand properties and applications of magnetic materials.
CO 4	Ability to understand properties and applications of special materials.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	1	1	2	1	-	1	1	-	1
CO 2	3	2	2	1	1	2	1	-	1	1	-	1
CO 3	3	2	2	1	1	2	1	-	1	1	-	1
CO 4	3	2	2	1	1	2	1	-	1	1	-	1

UNIT I

Conducting Materials: Energy band diagram of conductors, semiconductors and insulators. Conductivity and Resistivity, factors affecting the resistivity, classification of conducting materials, electrical, mechanical and thermal properties and applications of low resistance materials like copper, aluminium, steel, silver, gold, platinum, brass and bronze. Electrical, mechanical and thermal properties and applications of high resistance materials like manganin, constantan, nichrome, mercury, tungsten and carbon. Introduction of super conductors. [T1,T2]

UNIT II

Insulating Materials: Classification of insulating materials, electrical, physical, thermal, chemical, mechanical properties of insulating materials. Thermoplastic and natural insulating materials, Gaseous and liquid insulating materials, properties and applications of ceramics and synthetic insulating materials. . [T1,T2]

UNIT III

Magnetic Materials: Introduction and classification of magnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop, coercive force and residual magnetism, concept of eddy current and hysteresis loss, curie temperature, magnetostriction effect. Soft and hard magnetic materials, ferro and ferri magnetic materials, special purpose magnetic materials. [T1,T2]

UNIT IV

Special Materials and components: Properties and applications of different materials used in electrical systems like – thermocouples, bimetallic, fusing, and soldering. Introduction to different types of materials used in electromagnetic and electromechanical systems, resistors, capacitors, inductors, special semiconductors used in electrical engineering. [T1,T2]

Textbook(s):

1. Electrical properties of materials by L. Solymer, Oxford University Press, 2014
2. An Introduction to Electrical Engineering Materials, C.S. Indulkar, S.Thiruvengadam, S. Chand Publishing, 4th edition, 2004

Reference Books:

1. Electronic Engineering Materials and Devices,J. Allison, Tata McGraw Hill Education,1973
2. Electrical Materials, Rob Zachariason, Delmar Cengage Learning, 2nd Revised edition 2011
3. Electrical Engineering Materials, Dekker Adrianu., PHI,1st edition, 2011
4. A Course In Electrical Engineering Materials, Seth S P, Dhanpat Rai, 3rd edition, 2011
5. Electrical and Electronic Engineering Materials by S.K. Bhattacharya, Khanna Publishers, New Delhi.

Paper Code(s): EEC-211	L	P	C
Paper: Electrical Machines – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of magnetic circuit and EMEC devices.
2.	To understand the concept of DC machines.
3.	To impart the knowledge of single phase transformer.
4.	To impart the knowledge of three phase transformer.

Course Outcomes (CO)

CO 1	Ability to understand the magnetic circuit and working of EMEC devices.
CO 2	Ability to understand the working and applications of DC motors.
CO 3	Ability to analyse of single phase transformer and solution of numerical problems.
CO 4	Ability to analyse of three phase transformer and solution of numerical problems.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3		2	1	2	1	2	1	-	2	2	-	2
CO 4	3	2	2	2	1	2	1	-	2	2	-	2

UNIT I

Principles of EMEC: Fundamentals of Magnetic Circuits, Energy in Electro-Magnetic Systems, Flow of Energy in Electro-Mechanical Devices, Energy and co-energy in Magnetic field, Singly and doubly excited systems, Electromagnetic and Reluctance Torque.
DC Generators: Constructional features, Armature winding details, lap & wave connections, EMF equation, separately excited, shunt, series and compound connected D.C. generators process of voltage build up in shunt generators, Characteristics and applications of separately/self-excited generators. [T1,T2]

UNIT II

DC Generators (Contd.): Armature Reaction, Demagnetizing and Cross-magnetizing armature MMF, Interpoles and compensating windings, commutation process and its improvement.
D.C. Motors: Speed and Torque Equation of D.C. motors, Characteristics of D.C. series, shunt and compound motors and their applications, Starting and speed control of D.C. motors, Braking of D.C. motors, Efficiency and testing of D.C. Machines, Introduction of D.C. servo motor and permanent magnet / brushless D.C. motors. [T1,T2]

UNIT III

Single phase Transformers: Transformer construction and practical considerations. Equivalent circuit(Exact and approximate), per unit values, Phasor diagram, Transformer testing : open circuit test, Short Circuit test, Sumpner's test, Efficiency and voltage regulation, All day efficiency. [T1,T2]

UNIT IV

3 phase Transformers: Three-phase Bank of Single-phase Transformers, Parallel operations of 1-phase and 3-phase transformers, load division between transformers in parallel. Three winding transformers, Zigzag connections, vector grouping with clock convention, tertiary winding, tap changing, phase conversions-3phase to 2 phase and 3phase to 6 phase.
Special Purpose Transformers: Auto-transformers. Welding, Traction, Instruments and pulse Transformers.
[T1,T2]

Textbook(s):

1. Electric Machinery, A Fitzgerald, Charles Kingsley, Stephen Umans, Tata McGraw Hill Education, 6th Edition, 2002.
2. Electrical Machines with MATLAB, Turan Gnen, CRC Press,Taylor&Francis, 2nd edition, 1998.

Reference Books:

1. The Performance and Design of Alternating Current Machines, M.G. Say, CBS Publishers, 2005
2. Electro-Mechanical Energy Conversion with Dynamics of Machines, Rakosh Das Begamudre, Wiley-Blackwell, 1988.
3. Performance and Design of Direct Current Machines: AE Clayton and NN Hancock, CBSPublishers, 2014
4. Oblems in Electrical Engineering: Power engineering and electronics with answers Partly Solved in I. Units: Parker Smith , CBS Publishers, 9th edition, 2003
5. Electric Machines, I J Nagrath D P Kothari, Mc Graw-Hill Education, 3rd edition, 2011
6. Samarjit Ghosh, "Electrical Machines", Pearson.

Paper Code(s): ECC-213 / ECC-216	L	P	C
Paper: Electromagnetic Field Theory	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic laws of electrostatics.
2.	To impart the knowledge of electromagnetics.
3.	To impart the knowledge of solution to real life plan wave problems for various boundary conditions.
4.	To impart the knowledge of characteristics and impudence transformation on high frequency transmission lines.

Course Outcomes (CO)

CO 1	Ability to understand the basic laws of electrostatics.
CO 2	To understand the basic laws of electromagnetics.
CO 3	Ability to provide solution of real life plan wave problems for various boundary conditions.
CO 4	To understand the characteristics and impudence transformation on high frequency transmission lines

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Introduction: Review of scalar and vector field, Dot and Cross products, Coordinate Systems-Cartesian, cylindrical and spherical. Vector representation of surface, Physical interpretation of gradient divergence and curl, Transformation of vectors in different co-ordinate systems, dirac-delta function.
Electrostatics: Electric field due to point-charges, line charges and surface charges, Electrostatic potential, Solution of Laplace and Poisson's equation in one dimension, M-method of image applied to plain boundaries, field mapping and conformal transformation, Electric flux density, Boundary conditions. Capacitance: calculation of capacitance for simple rectangular, cylindrical and spherical geometries, Electrostatic energy.
[T1,T2]

UNIT II

Magnetostatics : Magnetic Induction and Faraday's Law, Magnetic Flux Density, Magnetic Field Strength H, Ampere, Gauss Law in the Differential Vector Form, Permeability, Energy Stored in a Magnetic Field, Ampere's Law for a Current Element, Volume Distribution of Current , Ampere's Law Force Law, Magnetic Vector Potential, The Far Field of a Current Distribution, Maxwell's Equations: The Equation of Continuity for Time Varying Fields, Inconsistency of Ampere's Law, Maxwell's Equations, Conditions at a Boundary Surface.
[T1,T2]

UNIT III

Electromagnetic Waves: Continuity equations, Displacement current, Maxwell's equation, Boundary conditions, Plane wave equation and its solution in conducting and non-conducting media, Phasor notation, Phase velocity, Group velocity, Depth of penetration, Conductors and dielectrics, Impedance of conducting medium. Polarization, Reflection and refraction of plane waves at plane boundaries, Poynting vectors, and Poynting theorem. [T1,T2]

UNIT IV

Transmission Lines: Transmission line equations, Characteristic impendence, Distortion-less lines, Input impendence of a loss less line, computation of primary and secondary constants, Open and Short circuited lines, Standing wave and reflection losses, Impedance matching, Loading of lines, Input impedance of transmission lines, RF lines, Relation between reflection coefficient and voltage standing wave ratio (VSWR), Lines of different lengths – $\lambda/2$, $\lambda/4$, $\lambda/8$ lines, Losses in transmission lines, Smith chart and applications, impedance matching Single stub, Double stub. [T1,T2]

Textbook(s):

1. Matthew N. O. Sadiku , "Elements of Electromagnetics", Oxford University Press
2. E. C. Jordon, K. G. Balman, "Electromagnetic Waves & Radiation System" PHI – 2nd Edition

Reference Books:

1. William H. Hayt, "Engineering Electromagnetics", TMH
2. J.D. Kraus, "Electromagnetics", TMH
3. David K. Cheng," Field and Wave Electromagnetic", 2nd Edition, Pearson Education Asia,2001
4. John R. Reitz, "Foundations of Electromagnetic Theory". Pearson

Paper Code(s): ECC-215	L	P	C
Paper: Electronics – I	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Impart the knowledge of semi-conductor diodes and their applications.
2.	To Impart the knowledge of Transistors.
3.	To Impart the knowledge of code, logic gates and combinational logic circuits
4.	To Impart the knowledge of sequential logic circuits.

Course Outcomes (CO)

CO 1	The students are able to understand the working of various diodes.
CO 2	The students are able to understand the working of transistor and their applications.
CO 3	The students are able to understand the function of logic gates and design of combinational logic circuits.
CO 4	The students are able to understand the function and design of sequential logic circuits.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT-I

Evaluation of Electronics: Energy Band Structures In Metals, Semiconductors And Insulators, Theory Of Semiconductors: Classification Of Semiconductors, Conductivity Of Semiconductors, Carrier Concentration In Intrinsic & Extrinsic Semiconductors, Properties Of Intrinsic And Extrinsic Semiconductors, Fermi Level In A Semiconductor Drift And Diffusion Currents.
Theory of p-n junction Diode: Diode Current Equation, Diode Resistance, Transition Capacitance, Diffusion Capacitance, (Elementary treatment only), Effect of Temperature on p-n Junction Diode, Switching Characteristics,
Special Diodes: Zener Diode, Varactor Diode, Tunnel Diode, Photodiode, Light Emitting Diodes, Schottky Barrier Diode, Applications of Diodes: Half-Wave Diode Rectifier, Full-Wave Rectifier, Clippers and Clampers (Elementary treatment only). [T1]

Unit – II

Bipolar junction transistor: Introduction of transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations CB, CE, CC configurations, hybrid model for transistor at low frequencies, Introduction to FETs and MOSFETs. [T1]

Unit – III

Number Systems and Codes:- Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.
Combinational Logic Circuits:- Review of basic gates- Universal gates, Adder, Subtractor ,Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL. [T2]

UNIT- IV

Sequential Logic Circuits: - Latches and Flip Flops- SR, , D, T and MS-JK Flip Flops, Asynchronous Inputs.
Counters and Shift Registers:- Design of Synchronous and Asynchronous Counters:- Binary, BCD, Decade and Up/Down Counters , Shift Registers, Types of Shift Registers, Counters using Shift Registers- Ring Counter and Johnson Counter. [T2]

Textbook(s):

1. S. Salivahanan, N. Suresh Kr. & A. Vallavaraj, “Electronic Devices & Circuit”, Tata McGraw Hill, 2008
2. R.P. Jain, “Modern Digital Electronics”, TMH, 2nd Ed.

Reference:

1. Sedra & Smith, “Micro Electronic Circuits” Oxford University Press, 2000.
2. B.Kumar & Shail Bala Jain, “Electronic Devices And Circuits” PHI.
3. Boylestad & Nashelsky, “Electronic Devices & Circuits”, Pearson Education, 10TH Edition.
4. Morris Mano, Digital Logic and Computer Design”, Pearson.

Paper Code(s): ICC-205	L	P	C
Paper: Engineering Electromagnetics	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the basic laws of electromagnetism.
2.	To impart the knowledge of solution to real life plane wave problems for various boundary conditions and analyse the field equations for the wave propagation in special cases.
3.	To impart the knowledge of characteristics and carryout impudence transformation on high frequency transmission lines.
4.	To impart the knowledge of the wave propagation on metallic waveguides.

Course Outcomes (CO)

CO 1	To understand the basic laws of electromagnetism.
CO 2	To provide solution of real life plane wave problems for various boundary conditions and analyse the field equations for the wave propagation in special cases.
CO 3	Understand the characteristics and carryout impudence transformation on high frequency transmission lines.
CO 4	Analyze wave propagation on metallic waveguides in modal form.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Vector algebra and vector calculus with significance of del operators-theorems and applications, Maxwell's equations (for static, time varying fields) in integral and differential forms, Continuity equation, boundary conditions for electric magnetic fields, Programmatic solutions to Maxwell's equations using MATLAB, Poisson's and Laplace's equations.

UNIT II

Electromagnetic waves: wave generation and equations in free space, lossy and lossless dielectrics, conductors-skin depth – Plane wave reflection and refraction – Standing Wave – Applications. Wave propagation in lossless and conducting medium, phase and group velocity, Reflection by a perfect conductor, insulator, Brewster Angle, surface impedance. Guided waves and flow of power: Poynting vector and Poynting theorem, applications, power less in a conductor.

UNIT III

Transmission Lines: General solution for transmission lines – Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, meaning of reflection coefficient wavelength and velocity of propagation, distortion less transmission line, impedance matching – quarter wave line, single stub matching, double stub matching, Power transfer, Microstrip transmission line, Smith chart.

UNIT IV

Waveguides: Rectangular waveguide, characteristic of TE and TM waves-cutoff wavelength and phase velocity impossibility of TEM waves in waveguides-dominant mode, Surface currents, Attenuation, impedances. Circular wave guides-solution of field equations in cylindrical coordinates-TE and TM waves in circular guides – wave impedance and characteristic impedance, Microwave cavities: rectangular cavity resonators, circular cavity resonators-Q-factor.
Introduction to antenna: monopole and dipole antenna.

Textbook(s):

1. M. N. O. Sadiku , "Elements of Electromagnetics", Oxford University Press 2007
2. W. H. Hayt, "Engineering Electromagnetics", Tata McGraw Hill, 2006

Reference Books:

1. E. C. Jordon, K. G. Balman, "Electromagnetic Waves & Radiation System" Prentice Hall, India
2. G. S. Rao, "Electromagnetic Field Theory and Transmission lines" Wiley India.
3. David M. Pozar, "Microwave Engineering" John Wiley – 2nd edition.

Paper Code(s): EEC-207	L	P	C
Paper: Electrical Machines	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the concepts of DC Machines.
2.	To impart the concepts of Transformers.
3.	To impart the concepts of Induction Motors.
4.	To impart the concepts of Synchronous Motors.

Course Outcomes (CO)

CO 1	Ability to understand working and applications of DC Motors.
CO 2	Ability to understand working and analysis of Transformers.
CO 3	Ability to understand working and applications of Induction Motors.
CO 4	Ability to understand working and applications of Synchronous Machines

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	-	2	1	-	2
CO 2	3	3	1	3	3	2	1	-	3	1	-	2
CO 3	3	3	3	3	3	3	1	-	2	1	-	1
CO 4	3	3	3	3	3	2	1	-	2	1	-	2

UNIT- I

Principles of Electromechanical Energy Conversion.DC machines: construction, armature windings, induced EMF equation, torque production, magnetization curve. Types of generators and motors, characteristics, commutation and interpoles, armature reaction, Speed control of dc motor and starting.
PMDC machine: Introduction and need of brushless motors [T1, T2]

UNIT- II

Transformers: construction, ideal and practical transformer, equivalent circuits, voltage regulation, maximum efficiency criterion. Open circuit and short circuit tests. Phasor diagrams on no load, full load, lagging and leading power factor loads. Three phase transformer.
Introduction to polyphase induction machines, production of rotating magnetic flux vector, principle of operation, importance of air gap, comparison with transformer, types of rotor. [T1, T2]

UNIT- III

Induction motors: Development of an equivalent circuit, estimation of parameters, no load and block rotor tests. Torque slip characteristics, starting of induction motors methods, deep bar and double cage rotor, power relations, speed control of induction motors.

Single phase induction motor, double field revolving theory, starting methods of single phase induction motors, universal motor and introduction to switched reluctance motor. [T1, T2]

UNIT- IV

Synchronous Machine: construction, pitch factor and distribution factor, induced emf equation, equivalent circuits and phasor diagrams, power relations, OCC and SCC characteristics for voltage regulation of alternator, salient pole and cylindrical rotor machines and phasors. Effect of excitation and V curves. Power factor correction and parallel operation of synchronous generator. [T1, T2]

Textbook(s):

1. I.J Nagrath and D.P.Kothari, “Electrical Machines”, Tata Mc Graw Hill, 2010, Fourth Edition.
2. Bhag S. Guru, Huseyin R. Hiziroglu, “Electric Machinery and Transformers”, Oxford Pub., 3rd Ed.

Reference Books:

1. M. V. Deshpande, “Electrical Machines” PHI.
2. PC Sen, “Principles of Electric Machinery and Power Electronics”, Wiley and Sons, Third Edition.
3. Ashfaq Hussain, “Electrical Machines”, Dhanpat Rai.
4. Fitzgeral, A.E. , C.Kingslay & Umans, “Electrical Machines”, Mc Graw Hill.
5. Ghosh, “ Electrical Machines”, Pearson.

Paper Code(s): EEC-213 / EEC-208	L	P	C
Paper: Circuits and Systems	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of various signal and system.
2.	To understand modelling of circuit.
3.	To impart knowledge of theorems in AC circuit.
4.	To impart knowledge of two port network and transfer function.

Course Outcomes (CO)

CO 1	Ability to understand properties of signal and system.
CO 2	Ability to determine transient respond of circuit.
CO 3	Ability to solve AC circuit.
CO 4	Ability to determine two port parameter and transfer function.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	-	-	-	1	1	1	1
CO 2	3	3	3	3	2	-	-	-	1	1	1	1
CO 3	3	3	3	3	2	-	-	-	1	1	1	1
CO 4	3	3	3	3	2	-	-	-	1	1	1	1

UNIT – I

Signals, Classification of Signals, Systems, Classification of Systems, Linear Time Invariant (LTI) Systems; Laplace Transform, z-Transform, Fourier Series and Transform (Continuous and Discrete) and their properties. Laplace Transform and Continuous Time LTI systems, z-Transform and Discrete Time LTI systems, Fourier analysis of signals and systems, State Space Analysis. [T1]

UNIT-II

System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform. [T2]

UNIT – III

AC Circuits: Circuits containing Capacitors and Inductors, Transient Response, Alternating Current and Voltages, Phasors, Impedances and Admittance, Mesh Analysis, Loop Analysis, Nodal Analysis, Thevenin's and Norton's Theorem, Y - D and D- Y Transformation, Bridge Circuits. Resonant Circuits, Complex Frequency and Network Function, Two port Networks. Passive Filters. [T2]

UNIT – IV

Graph theory: concept of tree, tie set matrix, cut set matrix and application to solve electric networks.
Two port networks – Introduction of two port parameters and their interconversion, interconnection of two 2-port networks, open circuit and short circuit impedances and ABCD constants, relation between image impedances and short circuit and open circuit impedances. Network functions, their properties and concept of transform impedance, Hurwitz polynomial. [T2]

Textbook(s):

1. B. P. Lathi, “Signal Processing and Linear System”, Berkeley Cambridge Press, 1998.
2. A. H. Robbins and W. C. Miller, “Circuit Analysis: Theory and Practice”, Thomson Learning/Delmar Pub., 2007.

Reference Books:

1. S. Haykin and B. V. Veen, “Signal and Systems”, John Wiley and Sons, 1999.
2. H. P. Hsu, “Schaum’s Outlines of The Theory and Problems of Signals and Systems”, McGraw-Hill, 1995.
3. S. Madhu, “Linear Circuit Analysis”, Prentice Hall, 1988.
4. S. Ghosh, “Signals and Systems”, Pearson Education, 2006.
5. S. Poornachandra, “Signal and Systems”, Thomson Learning, 2004.
6. M. Nahvi and J. A. Edminister, “Schaum’s Outline of Theory and Problems of Electric Circuits”, McGraw-Hill, 2003.

Paper Code(s): ECC-219	L	P	C
Paper: Analog Electronics	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of Diodes.
2.	To understand the working of transistor based amplifiers.
3.	To impart the knowledge of operational amplifier and its applications.
4.	To impart the knowledge of various wave form generators.

Course Outcomes (CO)

CO 1	Ability to understand working and application of various Diodes.
CO 2	Ability to analyse various amplifier circuits.
CO 3	Ability to understand working and applications of operational amplifier.
CO 4	Ability to analyse different waveform generators.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

Unit I

Evaluation Of Electronics: Energy Band Structures In Metals, Semiconductors And Insulators, Properties Of Intrinsic And Extrinsic Semiconductors,
Theory of p-n junction Diode: Diode Current Equation, Diode Resistance, Transition Capacitance, Diffusion Capacitance, Switching Characteristics, Special Diodes: Zener Diode, Varactor Diode, Tunnel Diode, Photodiode, Light Emitting Diodes, Schottky Barrier Diode, Applications of Diodes: Half-Wave Rectifier, Full-Wave Rectifier, Clippers and Clampers (Elementary treatment only). [T1]

Unit II

Bipolar junction transistor: Introduction of transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations CB, CE, CC configurations
Small signal amplifiers: CB, CE, CC configurations, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid band model, gain & impedance, comparisons of different configurations, Emitter follower, Darlington pair, Multistage amplifiers, Feedback amplifiers. [T1]

UNIT III

Linear & Non Linear Wave shaping: , Inverting and non-inverting amplifiers, voltage follower, difference amp, adders, Voltage to current with floating & grounded load, current to voltage converter, practical integrator & differentiator, Clipping & Clamping circuits, Comparators, log/antilog circuits using Op-Amps, precision rectifiers(half & full wave),peak detector, Inverting & non inverting Schmitt trigger circuit.
Waveform generations: Sine wave generator (Phase shift, Wein bridge, Hartley & Colpitts), Barkhausen criteria of oscillations, conditions for oscillation, cystal oscillator. [T2]

UNIT IV

Waveform generators: Square and triangular waveform generators (determine period and frequency), saw tooth wave generator, Astable multi-vibrator, Monostable and Bistable Multivibrator.
Active RC Filters: Idealistic & Realistic response of filters (LPF, BPF, HPF, BRF), Butter worth & Chebyshev approximation filter functions All pass, Notch Filter. IC phase locked loops, IC voltage regulators, IC VCO.
[T2]

Textbook(s):

1. Salivahanan , Suresh Kumar, Vallavaraj, “Electronic Devices and Circuits” TMH, 1999
2. D. Roy Choudhary, Shail B Jain, “Linear Integrated Circuits” New Age Publisher, 1999.

Reference Books:

1. B. Kumar ,Shail Bala Jain, “Electronic Devices and Circuits” PHI.
2. M.Rashid , “Microelectronic Circuit”, Cengage Learning Publication.
3. Sedra & Smith, “Micro Electronic Circuits” Oxford University Press, 2000
4. David A Bell, “Operational Amplifiers and Linear IC’s”, PHI.

Paper Code(s): MEC-205	L	P	C
Paper: Theory of Machines	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart knowledge of various types of mechanisms and perform their synthesis by analytical and graphical method.
2.	To develop the understanding of Gears, Gear trains and Gyroscope.
3.	To facilitate students to understand the function and working of flywheels and governor.
4.	To learn and study the phenomena of balancing and mechanical vibrations.

Course Outcomes (CO)

CO 1	Examine various types of mechanisms and execute their kinematic analysis.
CO 2	Explain the concept of Gears, Gear Trains and Gyroscope.
CO 3	Describe the working principle of flywheel and governor.
CO 4	Understand the concept of balancing and mechanical vibration system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	2	-	-	-	-	-	2
CO 3	3	3	3	3	-	2	-	-	-	-	-	2
CO 4	3	3	3	3	-	2	-	-	-	-	-	2

UNIT-I

Mechanisms And Machines: Introduction of Simple mechanism, Different types of Kinematics pair, Grubler's rule for degree of freedom, Grashof's Criterion for mobility determination, Inversions of 4R, 3R-P, and 2R-2P chains. Kinematic Analysis of Planar Mechanisms: Velocity and acceleration diagrams, Application of relative velocity method in Slider crank and four bar mechanism, Instantaneous centre method, Kennedy-Arnold theorem, Acceleration diagrams for simple mechanism.
Cams: Classification, Construction of Cam profile, Analysis of Cams with uniform acceleration, and retardation, SHM, Cycloidal motion.

UNIT-II

Gears and Gear Trains: Classification of gears, Terminology, Geometry of tooth profiles, Law of gearing, Cycloidal and Involute profile, Undercutting and interference, Methods to avoid interference, Condition for minimum number of teeth to avoid interference, Contact ratio, Interference, Simple, Compound and Epicyclic gear trains, Tabular column method for Epicyclic gear trains, Fixing torque.
Gyroscopes: Principles of Gyroscope, Effect of Gyroscopic couple on automobiles, ships and aircrafts.

UNIT-III

Dynamic Analysis: Analysis of single slider crank mechanism for displacement, velocity and acceleration using analytical method, Klein’s Construction, Turning moment diagrams, Flywheel.
Mechanical governors:Function of a governor, types of governors: weight and spring loaded, Hunting and Sensitivity, efforts and power of a governor, controlling diagrams.

UNIT - IV

Balancing: Static and Dynamic balancing, balancing of rotating and reciprocating masses, single and multicylinder engines.
Vibrations: Free vibration of a body, single degree of freedom system, Rayleigh method, free vibrations with viscous damping, Logarithmic decrement, Response of damped spring mass system to harmonic forces, Whirling of shafts, Vibration isolation, Transmissibility Ratio.

Textbook(s):
1. S.S. Rattan, “Theory of Machines”, Tata McGraw Hill.
2. V.P. Singh, “Theory of Machines”, Dhanpat Rai & Co.(P)Ltd.

References:
1. J E Shigley “Theory of Machines”, Pearson.
2. Thomas Beven, “The Theory of Machines”, CBS Publishers.
3. R.L. Norton, “Kinematics and Dynamics of Machinery”, Tata McGraw-Hill.
4. P.L. Ballaney, “Theory of Machines & Mechanism”, Khanna Publishers.

Paper Code(s): MEC-207	L	P	C
Paper: Strength of Materials	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand about different types of load conditions and determine the stress, strain and change in geometrical parameters of different types of materials.
2.	To understand the resistance mechanism of beams due to bending and shearing.
3.	To understand the principal stresses, behaviour of torsional members, columns and failure mechanisms in materials.
4.	To understand the difference between thin & thick pressure vessels and the design of springs.

Course Outcomes (CO)

CO 1	Evaluate the stress induced in structural members subjected to tension, compression, tangential and thermal loads.
CO 2	Analyse the performance of the beam for different types of loads and support conditions using SFD and BMD and determine the bending stress, shear stress and deflection induced.
CO 3	Analyse the stress induced in columns and members under torsion.
CO 4	Distinguish between thin and thick pressure vessels and estimate the different stresses induced in pressure vessels and springs.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	2	-	-	-	-	-	2
CO 2	3	3	3	3	-	3	-	-	-	-	-	2
CO 3	3	3	3	3	-	3	-	-	-	-	-	2
CO 4	3	3	3	2	-	3	-	-	--	-	-	2

UNIT-I

Simple Stresses & strains: Concept of stress and strain. Hooke's law, Stress-Strain diagram, factor of safety, Elongation of tapering bars of circular and rectangular cross sections, Elongation due to self-weight. Saint Venant's principle, Compound bars, state of simple shear, complementary shear stress, Volumetric stresses and Strains, Elastic constants and their relationship, Thermal stresses, Compound section subjected to thermal stresses, Sudden, gradual & impact load, Strain energy & Proof Resilience, Strain energy under normal and shear stress.

UNIT-II

Shear Force and Bending Moment in Beams: Types of beams, supports and loadings, Definition of bending moment and shear force, Sign conventions, relationship between load intensity, Bending moment and shear force, Shear force and bending moment diagrams for statically determinate beams subjected to points load, Uniformly distributed loads, Uniformly varying loads, Couple and their combinations.

Bending and Shear Stresses in Beams: Introduction, Pure bending theory, Assumptions, Derivation of bending equation, Modulus of rupture, Section modulus, Flexural rigidity, Beam of uniform strength, Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for circular, rectangular, 'I', and 'T' sections, Castigliano's theorem, Shear Centre (only concept).

Slope and deflection of Beams: Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment curvature equation, Double integration method, Macaulay's method and Principle of superposition method, Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple. [12]

UNIT-III

Columns: Introduction, Short, Medium and Long columns, Slenderness ratio, Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine-Gordon's formula for columns.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts, Power transmitted by shafts, Shaft in series and parallel, Combined bending and torsion.

Compound stresses and strains: State of stress at a point, General two-dimensional stress system, Principal stresses and strains, Principal planes. Mohr's circle of stresses, Theories of Failures.

UNIT - IV

Springs: Analysis of Close-coiled helical springs, Springs in series and parallel, Stress in leaf springs.

Pressure vessels: Thin cylindrical and Spherical vessels subjected to internal pressure, Hoop stresses, Longitudinal stress and change in volume, Thick cylinders subjected to internal and external pressure, Lame's equation, Radial and hoop stress distribution.

Textbook(s):

1. Sadhu Singh, "Strength of Materials", Khanna Pub.
2. S.S. Bhavikatti, "Strength of Materials", Vikas Publishers;(2000)
3. R.K. Bansal, "A Textbook of Strength of Materials", Laxmi Publications; 4th ed.(2010)

References:

1. S.P. Timoshenko and J. Gere, "Elements of Strength of Materials", East-West affiliated, New Delhi.
2. R.C. Hibbler, "Mechanics of Materials", Prentice Hall, New Delhi;(1994)
3. L.S. Sri Nath et.al., "Strength of Materials", McMillan, New Delhi;(2001)
4. Eger P. Popov, "Engg. Mechanics of solids", Prentice Hall, New Delhi;(1998)
5. Roger T. Fenner, "Mechanics of Solids", U.K. B.C. Publication, New Delhi;(1990)

Paper Code(s): MEC-209	L	P	C
Paper: Manufacturing Science & Technology - I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To acquire knowledge in casting processes and develop an understanding of the various variables which control the casting process.
2.	To introduce students to different welding processes, weld testing and advanced processes.
3.	To acquire a fundamental knowledge on metal forming technology.
4.	To make student familiar with the various sheet metal work and powder metallurgy.

Course Outcomes (CO)

CO 1	Understand the working of different manufacturing processes and apply knowledge to use appropriate manufacturing process based on the need.
CO 2	Identify the capabilities of the different manufacturing processes.
CO 3	Analyse the different design aspects of the manufacturing processes
CO 4	Evaluate the effects of process parameters on the performance of Manufacturing processes and prepare a report in a team for different processes.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	-	-	2	-	-	-	-	-	-
CO 2	3	2	2	-	-	2	-	-	-	-	-	-
CO 3	3	3	3	2	-	2	-	-	-	-	-	-
CO 4	3	3	3	3	-	2	-	-	3	3	-	-

UNIT-I

Casting: Introduction to sand moulding, Testing of moulding sand, Moulding and core making machine, Design of metal moulds, Gating system and its design, Riser design and its placement, Mould filling time, Melting, Pouring and Fluidity, Selection of melting furnaces, Control of melt and Cupola charge calculations, Solidification of pure metals and alloys, Solidification time, Fundamentals of Casting of complicated shapes: automotive components, casting of light alloys – Aluminium, Magnesium and Titanium alloys and Other casting processes, like investment, continuous, slush, squeeze casting, stir casting.

UNIT-II

Welding: Types of metal transfer in arc welding, Analysis of Voltage-Arc length Characteristics, Welding processes like GTAW, GMAW and SAW processes and their recent variants, Plasma arc welding process: transferred and non- transferred arc welding and their applications, Plasma cutting, Surfacing and plasma spray forming, Explosive, Ultrasonic, Laser Beam, Electron Beam, Friction Stir, Thermit, Atomic Hydrogen welding, Cold metal transfer Welding, Resistance welding, Soldering and brazing, welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys, Soldering, Brazing and their applications, Joint design, welding symbols and Joint evaluation through destructive and non-destructive testing methods, Defects in welding: causes and remedies, Related numerical problems on electric arc welding and resistance welding.

UNIT-III

Forming: Plastic deformation of metals, Elements of theory of plasticity, Flow curve, True stress & true strain, stress-strain relationships, Yield criteria for ductile metals, Von Misses & Teresa yield criteria, combined stress tests, Hot working and Cold working, Friction and lubrication in metal working, Analysis of bulk forming Process: Extrusion: Analysis of extrusion process, extrusion pressure, Rolling: Forces & geometrical relationship in rolling, Rolling load and torque in cold rolling, Von-Karman work equation, Wire and Tube Drawing, Drawing stress, Reduction factor, Unconventional forming processes, Defects in metal forming.

UNIT - IV

Sheet Metal and other Processes: Classification - conventional and HERF processes-presses-types and selection of presses, formability of sheet metals- principle, process parameters, equipment and application of the following processes: deep drawing, spinning, stretch forming. Plate bending, spring back, press brake forming, Introduction to forming, electro hydraulic forming, magnetic pulse forming. Introduction to press work – coining, embossing etc., Design of sheet metal dies. Powder Metallurgy: fabrication routes, powder size determination – micro and nano level, powder consolidation routes, compacting, sintering, hot pressing, sintering, hot isostatic pressing, field assisted sintering technologies.

Textbook(s):

1. Kalpakjian, "Manufacturing Engineering and Technology", Addison Wesley.
2. A. Ghosh and A.K. Mallik, "Manufacturing Science", East West Press.

References:

1. M.P. Groover, "Modern Manufacturing Processes".
2. R. W. Heine, C. R. Loper and P. C. Rosenthal, "Principles of Metal Casting", Tata-McGraw Hill.
3. G. E. Dieter, "Mechanical Metallurgy (Part IV)", Tata-McGraw Hill.
4. B. Avitzur, "Metal Forming: Processes and Analysis".
5. G.W. Rowe, "Industrial Metal Working Processes".

Paper Code(s): MEC-211	L	P	C
Paper: Thermal Engineering – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of laws of thermodynamic and apply them to determine the feasibility of any process.
2.	To understand the principles of pure substance and to be able to determine exergy of any system.
3.	To understand the principle of vapour power cycle and its thermal refinement.
4.	To understand the working of I.C engine and Gas Turbine engine and able to compute its performance parameters.

Course Outcomes (CO)

CO 1	Develop understanding of first and second law of thermodynamics and use it to determine feasibility of a process
CO 2	Evaluate the properties of a pure substance using different property relations and determine entropy changes for different types of processes and the reversibility or irreversibility of such processes.
CO 3	Analyze the performance of simple Rankine cycle and improve its performance with thermal refinement.
CO 4	Examine various gas power cycles and their applications in automotive and aviation sector.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	2	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	3	-	-	2	-	-	-	-	2

UNIT-I

Basic definitions and Laws of Thermodynamics: Thermodynamic systems: Closed, Open and Isolated systems, Microscopic and Macroscopic view, Intensive and Extensive properties, Zeroth law of Thermodynamics, Phase, State, Process, Cycle, Point functions and Path functions, Work and Heat, First Law of Thermodynamics, Internal energy, Non flow processes, Concept of Flow work, Analysis of steady flow and unsteady flow processes and their applications, Limitations of First law, Second Law of Thermodynamics, Reversible and Irreversible processes, Reversed Carnot cycle, Carnot's Theorem, Clausius inequality, Entropy, Change in Entropy during various processes.

UNIT-II

Availability and Irreversibility: High grade and low grade energy, Available and unavailable energy, Dead state, Loss of available energy due to Heat transfer through a Finite temperature difference, Availability, Reversible

work and Irreversibility, Availability in non flow systems, Second law efficiency.
Thermodynamic Property Relations: Maxwell Relations, Clapeyron Equation.
Properties of a Pure Substance: Phase equilibrium of a pure substance on T-V diagram, Normal boiling point of Pure substance, Saturation states, Compressed liquid, P-V & P-T diagram of a pure substance, Steam and its different states, Use of Steam tables and Mollier diagram, Different processes of vapour on P-V and T-S diagrams, Measurement of Dryness fraction.

UNIT-III

Vapour Power Cycles: Carnot vapour power cycles, drawbacks as a reference cycle, Simple Rankine cycle, description, T- S diagram, Analysis for performance, comparison of Carnot and Rankine cycles, Effects of pressure and temperature on Rankine cycle performance, Actual vapour power cycles, Ideal and practical regenerative Rankine cycle, open and closed feed water heaters, Reheat Rankine cycle.
Boiler: Classification of Boiler, Boiler mountings and Boiler Accessories, Once through Boiler, Working and construction of Babcock and Wilcox boiler, Lancashire boiler.

UNIT – IV

Gas power cycle: Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Two stroke and Four stroke Cycles, Working of S.I Engine and C.I Engine, Valve timing diagram of S.I engine and C.I engine.
Gas Turbines: Brayton cycle, Thermal refinements, Performance of Gas turbines, Combined cycle, Principles of Jet Propulsion, Turbojet engines.

Textbook(s):
1. P K Nag Basic and Applied Thermodynamics 5th edition McGraw Hill
2. Mathur & Sharma Internal Combustion Engine, Dhanpat Rai Publication.

References:
1. M.J. Moran & H.N. Shapiro “Fundamentals of Thermal Engineering” John Wiley & sons.
2. S L Somasundaram “Engineering Thermodynamics”, New Age International Publishers.
3. R. K. Rajput, “Engineering Thermodynamics”, Lakshmi Publications
4. Y. A. Cengel & M. A Boles “Thermodynamics- An Engineering Approach ”, 6th edition Tata McGraw Hill
5. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics”, Pearson.

Paper Code(s): CEC-205	L	P	C
Paper: Structural Analysis – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the concept of stress and strain for the calculation of internal forces in the structural member.
2.	To know the concept of shear force and bending moment.
3.	To calculate deflection in beams and column
4.	To familiarize students about the failure modes of materials.

Course Outcomes (CO)

CO 1	Define stress, strain, elastic constants, Hooke's Law, shear force, bending moment.
CO 2	Construct Mohr circle , shear force diagrams and bending moment diagrams to solve complex problems.
CO 3	Analyze principal stresses and principal strains, load carrying capacity of long columns with different end conditions.
CO 4	Determine bending and shear stress, slope and deflection of beams using various techniques, torsion of shafts.

Course Outcomes (CO) to Programme Outcomes (PO) mapping

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-	-	-

UNIT-I

Simple Stresses and Strains
Introduction, Normal and Shear stresses, Stress-Strain Diagrams, Hook's law, Modulus of elasticity, Elastic Constants, Principle stresses and strains, Mohr's circle.
One dimensional loading & Torsion
One dimensional loading on members of varying cross-section. Torsion: Introduction, Torsion of shafts of circular section, torque and twist- shear stress due to torque

UNIT-II

Shear Force and Bending Moment
Types of beams, loads and supports, shear force and bending moment diagram, bending stresses and shear stresses in beams.
Deflection of Beams
Deflection due to bending: The moment curvature relation, Macaulay's method, Moment area and Conjugate

beam method, Deflection of determinate plane frames using strain energy and unit load method, Elastic curve sketch.

UNIT-III

Analysis of determinate structure
Classification of Structures, Stress Resultants, Degree of Freedom per node, Static and Kinematic degrees of indeterminacy. Work and Energy. Strain energy of deformable systems, Betti's theorem of reciprocal work and Maxwell's theorem. Principle of virtual work and complementary virtual work, Principle of total minimum stationary potential energy, Stable and unstable equilibrium, Castigliano's Theorem I and II

UNIT - IV

Columns and Struts
Theory of Columns, long column and short column, Euler's formula, Columns with eccentric axial loads, Rankine's formula, Secant formula, Buckling and stability, slenderness ratio, combined bending and direct stress, effect of end conditions on column buckling.

Textbook(s):

1. A Textbook of Strength of Materials, Prof. R. K Bansal, Laxmi Publications.
2. Strength of Materials, RK Rajput, S Chand
3. Strength of Materials, B.C. Punmia, Laxmi Publications.

References:

1. Strength of Materials, Vol. I: Elementary Theory and Problems Paperback – 2004 ,S. Timoshenko CBS Publishers & Distributors Pvt. Ltd., New Delhi
2. Strength of Materials by Pytel and Singer, Harper Collins.
3. Strength of Materials by Ryder, Macmillan.
4. Strength of Materials by Timoshenko and &Youngs, East West Press.
5. Mechanics of Materials, Popov Nagarjan & Lu, Prentice Hall of India, N. Delhi.

Paper Code(s): CEC-207	L	P	C
Paper: Structural Design - I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To develop basic understanding of reinforced concrete and steel as a construction material
2.	To develop understanding of various design philosophies and their differences.
3.	To understand mix design and its implementation in structure.
4.	To understand and analyse construction management in structure.

Course Outcomes (CO)

CO 1	Define different types of concrete its characteristic and parameters as per the requirement of the structure.
CO 2	Infer the properties of concrete, the concept of design philosophies, and behavior of load bearing masonry walls and the principles of retaining wall.
CO 3	Identify preliminary data of concrete structure by the code recommendations and concept of limit states.
CO 4	Analyse construction management methods including project scheduling and networking.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	-	-							-	-	-
CO 2		2	3	-	-	-	1	-	-			
CO 3	-	-	2	-		2	-	-	-			
CO 4	-	2	-	-			-	-	-	-	3	-

UNIT-I

Construction Materials:Properties of Cement & Aggregate, Bulking of Sand. Hydration of cement, initial and final setting type.
Structural Steel – Composition and its type, material properties and behaviour; stress strain curve, relaxation of steel.
Concrete**:** Mechanical properties of concrete: elastic modules, poisson's ratio, creep, shrinkage and durability of concrete.

UNIT-II

Working stress and Limit state design concepts.
Introduction to Various Design Philosophies including characteristic strength, Partial Safety Factor, Factored Load, Design stress strain curve. Assumptions in Limit State Design Method. Constituents, mix design, short-term and long-term properties**. (IS 456, IS 800, IS 10262)**

UNIT-III

Structural Steel, and its designation as per **IS: 800:2007**, Properties of Structural steel. Basics of types of members (Tension member, Compression member and flexural member)
Connections – Types of connections. Rivet Connections, Bolted Connections and Welded Connections.

UNIT- IV

Project Planning: Project Scheduling, Controlling, Method of Planning.
PERT & CPM: Activity time estimate, Start and finish time of Activities, Critical Path and critical activities. Development of PERT Network. Time estimate using PERT.

Textbook(s):

1. S.K. Duggal, “Building Materials”, New Age International Publications.
2. L.S Negi, “Design of Steel Structure”, Tata McGraw-Hill.
3. N Subramanyam, “PERT & CPM”, Tata McGraw-Hill.

References:

1. Jain A.K., “Limit State Design of Reinforced Concrete Structures”., Nem Chand Publishers, Roorkee.
2. B.C. Purnima , R.C.C. Designs, Laxmi Publication
3. Raju K., “Reinforced Concrete”, New Age International (P) Ltd., New Delhi.
4. Unikrishna Pillai S., “Reinforced Concrete Design”., Tata McGraw Hill Publishing Company Ltd., New Delhi.

Paper Code(s): CEC-209	L	P	C
Paper: Fluid Mechanics	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce fundamentals of stagnant fluid.
2.	To elaborate fundamentals of flowing fluid and governing equations
3.	To understand fluid flow through different conduits and measurement techniques for it.
4.	To study the effect of fluid flow using the concepts of dimensional analysis

Course Outcomes (CO)

CO 1	Define the fundamental properties of fluid.
CO 2	Explain pressure forces acting on body(submerged and floating)
CO 3	Solve flow rate problems to determine the flow condition and forces exerted
CO 4	Examine flow around Models or Prototype using Dimensional Analysis approach.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	-	-	-	-	-	1	-	-
CO 2	3	3	3	2	2	-	-	-	-	1	-	-
CO 3	3	3	2	1	1	-	-	-	-	1	-	-
CO 4	2	3	3	3	1	-	-	-	-	1	-	-

UNIT-I

Introduction: Fluid properties, Ideal and real fluids, Density, Specific weight, specific volume, compressibility, specific gravity, Concept of viscosity, viscometer, cohesion, adhesion, surface tension, Capillarity, Newtonian and Non Newtonian Fluids;
Fluid Statics: Fluid pressure and its measurement, types of manometers, Total pressure and centre of pressure, principles of equilibrium, buoyancy, centre of buoyancy, meta centre, stability conditions of floating and submerged bodies, Evaluation of pressure force on dams, lock gates, curved surfaces, pressure distribution in liquid subjected to constant horizontal/vertical acceleration.

UNIT-II

Fluid Kinematics: Variation of flow parameters in space and time, Lagrangian and Eularian concepts in fluid motion, Types of fluid flow: steady and unsteady, uniform and non-uniform, rotational and irrotational, Laminar and turbulent, one, two and three dimensional flow, control volume, streamline, pathline and streakline, Continuity equation and its applications, Velocity potential and stream function, Cauchy-Riemann equation, flownet.
Types of motion: Linear translation, linear deformation, Angular deformation, Rotation, Vorticity, Free and forced vortex flow

UNIT-III

Fluid Dynamics : Newton's, Reynolds's, Navier-Stokes and Euler's equations of motion, Derivation of Bernoulli's equation from Euler's equation and its limitations, Applications of Bernoulli's equations-Orifice and Mouth piece, Orifice-meter, Venturimeter, Weir and notch, Pitot's tube, Siphon, etc; hydraulic gradient and total energy lines and their Engineering significance. Momentum equation, Moment of momentum equation-Assumptions and limitations, applications, impact of jets and forces in bends.

UNIT - IV

Dimensional and Model Analysis: Dimensional homogeneity, methods of dimensional analysis, Buckingham's π theorem, selection of Repeating variables, Forces acting on moving fluid, Dimensionless numbers and their Engineering significance, Model analysis, Geometric, Kinematic and Dynamic similarity, Model testing of partially submerged bodies, scale ratios for distorted models.

Textbook(s):

1. P. N. Modi and S. M. Seth "Hydraulics and Fluid Mechanics (incl Hydraulic Machines)" Standard Publications
2. Frank White, "Fluid mechanics" Tata McGraw Hill Publications.

References:

1. S. Ramamrutham, Hydraulics Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Company
2. Victor Streeter, "Fluid Mechanics", International Edition, Tata McGraw Hill Publications.
3. Hughes and Brighton, "Fluid Mechanics", Tata McGraw Hill.
4. Neville, "Fluid Mechanics", Pearson Education.

Paper Code(s): CEC-211	L	P	C
Paper: Geomatics Engineering	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To know the different methods and techniques used in surveying and the applications.
2.	To apply concepts of tachometry and levelling in surveying difficult and hilly terrains to obtain the topographical map of area.
3.	To use survey instruments in carrying out survey, collect data, write reports and able to perform required calculations.
4.	To build a map or plan of an area using surveying and levelling.

Course Outcomes (CO)

CO 1	Ability to understand the basic principles of surveying.
CO 2	Analyse and explain the various methods used in surveying and levelling.
CO 3	Apply the concepts various types of surveying in computation of distance, direction and elevation.
CO 4	Compare types of errors for different surveying techniques.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	3	-	-	-	-	-	-	-	-	-
CO 2	1	-	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	2	-	2	-	-	-	-	-	-	-
CO 4	-	2	2	-	-	-	-	-	-	-	-	-

UNIT-I

Linear Measurement: Introduction, Principles of chain survey, use and adjustment of various instruments employed in chain survey, chaining on sloping grounds, Offsets and error in offsets, Obstructions in chaining, chaining angles, Errors and sources of error, Introduction to advance linear measuring instruments, Field book.
Compass Survey: Use and adjustment of prismatic and surveyor's compass, Methods of surveying with a compass, Magnetic declination, local attraction, Errors in prismatic survey, plotting of compass survey, distribution of closing error.

UNIT-II

Levelling: definitions of terms used in levelling, different types of levels, parallax, staves, adjustments, bench marks, classification of levelling, booking and reducing the levels, rise and fall method, line of collimation method, errors in levelling, permanent adjustments, Two peg test, reciprocal levelling, Corrections to curvature and refraction, cross sections and longitudinal levelling.

Trigonometric Levelling: Definitions & terms, curvature & refraction Methods: direct & reciprocal, eye and object correction, coefficient of refraction. Contours: Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, uses of contour maps.

UNIT-III

Theodolite Traversing: types of theodolities, measurement of angles, temporary and permanent adjustments, closed & open traverse consecutive and independent co-ordinates, advantages & disadvantages of traversing closing error, Bowditch, Transit rules.

Triangulation: Principal, selection of base line and stations, order of triangulation, triangulation figures,scaffold and signals, marking of stations, Intervisibility and heights of stations, satellite stations, base linemeasurement and corrections, Introduction to adjustment of observations.

UNIT - IV

Photogrammetric Survey: Basic principles, elevation of a point, determination of focal length of lens, aerial camera, scale of a vertical photograph, relief displacement of a vertical photograph, height of object from relief displacement.

Curves: Types of curves, Elements of a curve, Simple curves, different methods of setting out, Introduction to compound, reverse, transition and vertical curves. Introduction to modern surveying Instruments /Techniques like Total station; Basics of remote sensing &GPS etc.

Textbook(s):

1 Surveying ,B.C. Punmia Vol - I,/II, Laxmi Publication
3 Surveying Vol -1 by K.R. Arora

References:

1. Plane and Geodetic Surveying by D. Clark
2. Plane and Geodetic Surveying by S. Ramamrutham
2 Surveying Vol.2, Duggal, McGraw Hill Education (I) Pvt.Ltd.
4 Surveying and Levelling by R. Subramanian

Paper Code(s): ECC-217	L	P	C
Paper: Analog and Digital Electronics	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of different types of Diodes.
2.	To impart the knowledge of Transistors.
3.	To impart the knowledge of logic gates and flip flops.
4.	To impart the knowledge of operational amplifier.

Course Outcomes (CO)

CO 1	Ability to understand working and applications of various Diodes.
CO 2	Ability to understand working of Transistors.
CO 3	Ability to understand function of gates and flip flops.
CO 4	Ability to understand applications of operational amplifier.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT-I

Evaluation of Electronics: Energy Band Structures In Metals, Semiconductors And Insulators, Theory Of Semiconductors: Classification Of Semiconductors, Properties Of Intrinsic And Extrinsic Semiconductors,
Theory of p-n junction Diode: Diode Current Equation, Diode Resistance, Effect of Temperature on p-n Junction Diode, Switching Characteristics, Special Diodes: Zener Diode, Varactor Diode, Tunnel Diode, Photodiode, Light Emitting Diodes, Schottky Barrier Diode, Applications of Diodes: Half-Wave Diode Rectifier, Full-Wave Rectifier, Clippers and Clampers (Elementary treatment only). [T1]

UNIT – II

Bipolar junction transistor: Introduction of transistor, construction, transistor operations, BJT characteristics, load line, operating point, leakage currents, saturation and cut off mode of operations CB, CE, CC configurations, hybrid model for transistor at low frequencies, Introduction to FETs and MOSFETs. [T1]

UNIT – III

Number Systems and Codes:- Decimal, Binary, Octal and Hexadecimal Number systems Conversion between various Codes.
Logic Circuits:- Review of basic gates- Universal gates, Adder, Subtractor , Comparators, - Latches and Flip

Flops- SR, , D, T and MS-JK Flip Flops [T2]

UNIT- IV

Op-Amp and its applications: Inverting and Non-inverting amplifiers, adder, sub-tractor, integrators, differentiator, instrumentation amplifiers, oscillators, multi vibrators, A to D and D to A converter. [T1]

Textbook(s):

1. S. Salivahanan, N. Suresh Kr. & A. Vallavaraj, “Electronic Devices & Circuit”, Tata McGraw Hill, 2008
2. R.P. Jain, “Modern Digital Electronics”, TMH, 2nd Ed.

Reference Books:

1. Sedra & Smith, “Micro Electronic Circuits” Oxford University Press, 2000.
2. B.Kumar & Shail Bala Jain, “Electronic Devices And Circuits” PHI.
3. Boylestad & Nashelsky, “Electronic Devices & Circuits”, Pearson Education, 10TH Edition.
4. Morris Mano, Digital Logic and Computer Design”, Pearson.

Paper Code(s): ES-251	L	P	C
Paper: Computational Methods Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Computational Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in C/C++

1. Program for finding roots of f(x)=0 Newton Raphson method.
2. Program for finding roots of f(x)=0 by bisection method.
3. Program for finding roots of f(x)=0 by secant method.
4. To implement Langrange's Interpolation formula.
5. To implement Newton's Divided Difference formula.
6. Program for solving numerical integration by Trapezoidal rule
7. Program for solving numerical integration by Simpson's 1/3 rule
8. To implement Numerical Integration Simpson 3/8 rule.
9. Inverse of a system of linear equations using Gauss-Jordan method.
10. Find the Eigen values using Power method.
11. Program for solving ordinary differential equation by Runge-Kutta Method.

Paper Code(s): ECC-253	L	P	C
Paper: Digital Logic and Computer Design Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Digital Logic and Computer Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design and implementation of adders and subtractors using logic gates.
2. Design and implementation of 4-bit binary adder/subtractor.
3. Design and implementation of multiplexer and demultiplexer.
4. Design and implementation of encoder and decoder.
5. Construction and verification of 4-bit ripple counter and Mod-10/Mod-12 ripple counter.
6. Design and implementation of 3-bit synchronous up/down counter.
7. Design and computer architecture: Design a processor with minimum number of instructions, so that it can do the basic arithmetic and logic operations.
8. Write an assembly language code in GNUsim8085 to implement data transfer instruction.
9. Write an assembly language code in GNUsim8085 to store numbers in reverse order in memory location.
10. Write an assembly language code in GNUsim8085 to implement arithmetic instruction.
11. Write an assembly language code in GNUsim8085 to add two 8 bit numbers.
12. Write an assembly language code in GNUsim8085 to find the factorial of a number.
13. Write an assembly language code in GNUsim8085 to implement logical instructions.
14. Write an assembly language code in GNUsim8085 to implement stack and branch instructions.

Paper Code(s): CIC-255	L	P	C
Paper: Data Structures Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Data Structures) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement sparse matrix using array. Description of program:
   a. Read a 2D array from the user.
   b. Store it in the sparse matrix form, use array of structures.
   c. Print the final array.
2. Create a linked list with nodes having information about a student and perform
   a. Insert a new node at specified position.
   b. Delete of a node with the roll number of student specified.
   c. Reversal of that linked list.
3. Create doubly linked list with nodes having information about an employee and perform Insertion at front of doubly linked list and perform deletion at end of that doubly linked list.
4. Create circular linked list having information about a college and perform Insertion at front perform Deletion at end.
5. Implement two stacks in a using single array.
6. Create a stack and perform Push, Pop, Peek and Traverse operations on the stack using Linked list.
7. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
8. Implement Experiment-2 using liked list.
9. Create a Binary Tree and perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
10. Implement insertion, deletion and traversals (inorder, preorder and postorder) on binary search tree with the information in the tree about the details of an automobile (type, company, year of make).
11. Implement Selection Sort, Bubble Sort, Insertion sort, Merge sort, Quick sort, and Heap Sort using array as a data structure.
12. Perform Linear Search and Binary Search on an array. Description of programs:
    a. Read an array of type integer.
    b. Input element from user for searching.
    c. Search the element by passing the array to a function and then returning the position of the element from the function else return -1 if the element is not found.
    d. Display the position where the element has been found.
13. Implement the searching using hashing method.
14. Create a graph and perform DFS and BFS traversals.

Paper Code(s): CIC-257	L	P	C
Paper: Object-Oriented Programming Using C++ Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Object-Oriented Programming Using C++) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program for multiplication of two matrices using OOP.
2. Write a program to perform addition of two complex numbers using constructor overloading. The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imag parts to equal values and third which takes two argument is used to initialized real and imag to two different values.
3. Write a program to find the greatest of two given numbers in two different classes using friend function.
4. Implement a class string containing the following functions:
    a. Overload + operator to carry out the concatenation of strings.
    b. Overload = operator to carry out string copy.
    c. Overload <= operator to carry out the comparison of strings.
    d. Function to display the length of a string.
    e. Function tolower( ) to convert upper case letters to lower case.
    f. Function toupper( ) to convert lower case letters to upper case.
5. Create a class called LIST with two pure virtual function store() and retrieve().To store a value call store and to retrieve call retrieve function. Derive two classes stack and queue from it and override store and retrieve.
6. Write a program to define the function template for calculating the square of given numbers with different data types.
7. Write a program to demonstrate the use of special functions, constructor and destructor in the class template. The program is used to find the bigger of two entered numbers.
8. Write a program to perform the deletion of white spaces such as horizontal tab, vertical tab, space ,line feed ,new line and carriage return from a text file and store the contents of the file without the white spaces on another file.
9. Write a program to read the class object of student info such as name , age ,sex ,height and weight from the keyboard and to store them on a specified file using read() and write() functions. Again the same file is opened for reading and displaying the contents of the file on the screen.
10. Write a program to raise an exception if any attempt is made to refer to an element whose index is beyond the array size.

Paper Code(s): ECC-255	L	P	C
Paper: Analog Communications Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Analog Communications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Generation of DSB-SC AM signal using balanced modulator.
2. To study amplitude demodulation by linear diode detector
3. Generation of SSB AM signal.
4. To study envelop detector for demodulation of AM signal and observe diagonal peak clipping effect.
5. To generate FM signal using voltage controlled oscillator.
6. To generate a FM Signal using Varactor & reactance modulation.
7. Detection of FM Signal using PLL & foster seelay method.
8. To study Super heterodyne AM receiver and measurement of receiver parameters viz.sensitivity, selectivity & fidelity.
9. To study Pre-emphasis and De-emphasis in FM.
10. Generation of Phase modulated and demodulated signal.

Paper Code(s): ECC-257	L	P	C
Paper: Analog Electronics – I Lab	**-**	**2**	**1**

Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term end Theory Examinations: 60 marks
Instructions: 1. The course objectives and course outcomes are identical to that of (Analog Electronics - I) as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & Calculate Static & Dynamic Resistance.
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
   a. Half Wave Rectifier
   b. Centre Tapped Rectifier.
   c. Bridge Rectifier.
4. Plotting input and output characteristics and calculation of parameters of a transistor in common emitter configuration.
5. Transistor biasing circuit. Measurement of operating point (Ic and Vce) for a :-
   a. fixed bias circuit
   b. potential divider biasing circuit.
6. Plot the FET characteristics & MOSFET characteristics.
7. To measure the overall gain of two stages at 1 KHz and compare it with gain of Ist stage, Also to observe the loading effect of second stage on the first stage
8. To plot the frequency response curve of two stage amplifier.
9. To study Emitter follower circuit & measurement of voltage gain and plotting of frequency response Curve.
10. Feedback in Amplifier. Single stage amplifier with and without bypass capacitor, measurement of voltage gain and plotting the frequency response in both cases.
11. To determine and plot firing characteristics of SCR by varying anode to cathode voltage, and varying gate current.
12. To note the wave shapes and voltages at various points of a UJT relaxation oscillator circuit.
13. For Transistorized push pull amplifier Measurement of optimum load, maximum undistorted power (by giving maximum allowable signal) Efficiency and percentage distortion factor.
14. To study the characteristics of single tuned & double tuned amplifier.

Paper Code(s): ECC-259	**L**	**P**	**C**
Paper: Signals and Systems Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Signals and Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Plot the linear convolution of two sequences.
4. Plot the correlation of two sequences.
5. Plot the magnitude and phase spectra of a signal using Fourier transforms.
6. Plot the magnitude and phase spectrum of signal using Fourier series.
7. Find out the Z transform of a signal and check the stability using pole zero location.
8. Plot the spectra of ideally sampled signal w.r.t. sampling of Discrete time signals.
9. Verification of few properties of Fourier transform.
10. Evaluate the DTFS coefficients of a signal and plot them.
11. Plot the step response for any impulse response entered by user.

Paper Code(s): EEC-257	L	P	C
Paper: Electrical Machines – I Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electrical Machines - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the construction and operation of various types of starters available in the laboratory for starting DC motors.
2. To study the magnetization characteristics of a separately excited D.C generator at different speeds and to find the critical field resistance at those speeds.
2. To perform the load test on D.C. shunt motor and to draw the performance characteristics.
3. To control the speed of a DC shunt motor by using
   (a) Field control
   (b) Armature/Rheostatic control
   (c) Supply voltage control
4. To perform the Swinburne's test on a D.C. shunt Machine and to pre determine its efficiency when running as a motor as well as generator and also draw the characteristic curves.
5. To conduct load test on DC shunt generator and obtain its internal and external characteristics.
6. To perform O.C./S.C. tests on a single phase transformer and determine equivalent circuit parameters.
7. To perform Sumpner's (back to back) test on two identical single phase transformers and draw the load efficiency graphs.
8. To perform load test on a single-phase transformer and determine the following:
   (a) Voltage ratio of transformer.
   (b) Efficiency at different loads.
   (c) Voltage regulation of the transformer.
9. To perform Polarity test on two single-phase transformers, connect them in parallel and study the load sharing between them.
10. To convert a three-phase supply into two phase supply using Scott-connection between two single phase transformers with suitable tapping. Verify the following:
    (a) Turn ratio between windings of main and teaser transformers.
    (b) Voltage of both phases of two phase supply is equal.
    (c) Whether the phase angle between them is 900.
11. To connect three-phase transformers in Y- Y / Y - Δ, Δ-Δ/Δ- Y connections and study line /phase voltage relationships.

Paper Code(s): EEC-259	L	P	C
Paper: Electrical Engineering Workshop	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions for paper setter
1. The course objectives and course outcomes are given below.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more.

Course Objectives :

1.	To Impart the knowledge components and design of DC power supply.
2.	To Impart the knowledge of components and accessories used in electrical installations.
3.	To Impart the knowledge of various illumination devices.
4.	To Impart the knowledge of fabrication of transformer and its testing.

Course Outcomes (CO)

CO 1	The students are able to understand the symbols, specification and application of components.
CO 2	The students are able to understand the connections/ wiring diagrams used in electrical installations.
CO 3	The students are able to understand the function of illumination devices.
CO 4	The students are able to understand to fabricate the transformer and assembly of domestic appliances.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT 1

Identification of hand tools, their specifications and purpose, safety precautions, first aid for electric shock, identification, specification of various types of resistors, capacitors, inductors, diodes, zener diodes, transistors, thyristors, LDR, VDR, UJT. Soldering and desoldering practice on wire and PCB.
Design and fabricate dc power supply using single diode half wave rectifier, two diodes full wave rectifier, 4 diode bride rectifier, capacitor filter, without and with regulator.

UNIT 2

Introduction to various electrical components and accessories used in wiring installation for example fuse, MCB, ELCB, switches etc. Introduction of different types of electrical wiring and wiring diagrams, selection (gauges, size etc.) and ratings of wires. Introduction to domestic and industrial wiring installations.

UNIT 3

Fabrication of different types of extension board. Study and wiring of a tube light circuit. Connection of fan with regulator circuit. Demonstration of various types of illumination devices like lamp, tube light, CFL and LED lamps. Trouble shooting of various home appliances.

UNIT 4

Study of various components of a small single phase step down transformer & its fabrication and testing. Safety measures regarding electric fire. Introduction to relays, contactors and starters, their specification and applications. Connecting a 3-phase induction motor through (a) D.O.L. starter (b) Star/delta starter, running & reversing the direction of rotation of motor.

Textbook(s):

1. Electrical Workshop: A Textbook Paperback by R. P. Singh, I K International Publishing House Pvt. Ltd; 2nd edition.
2. A Textbook of Electrical Workshop Practices by Umesh Rathore, Naresh Kumar Sharma, S.K. Kataria & Sons.

Paper Code(s): ECC-261	L	P	C
Paper: Electronics – I Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electronics - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & calculate static & dynamic resistance.
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
   a) Half Wave Rectifier
   b) Centre Tapped Rectifier.
   c) Bridge Rectifier.
4. To Plot Input & Output characteristics CB/CE/CC transistor.
5. Realization of basic gates.
6. Implementation of Boolean functions (two or three variables).
7. Realize all gates using NAND & NOR gates
8. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
9. Realize Master-Save J K Flip-Flop, using NAND/NOR gates
10. Realize Universal Shift Register
11. Realize Self-Starting, Self Correcting Ring Counter
12. Realize Multiplexer and De-Multiplexer

Paper Code(s): EEC-253 / EEC-254	L	P	C
Paper: Circuits and Systems Lab	**-**	**2**	**1**

Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term end Theory Examinations: 60 marks
Instructions: 1. The course objectives and course outcomes are identical to that of (Circuits and Systems) as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Plot the linear convolution of two sequences
4. Study the transient response of series RLC circuit for different types of waveforms on CRO and verify using MATLAB
5. Study the time response of a simulated linear system and verify the unit step and square wave response of first order and second order, type 0,1 system
6. To determine Z and Y parameters of the given two port network.
7. To determine ABCD parameters of the given two port network.
8. To verify various theorems in AC Circuits.
9. To determine Hybrid parameters of the given two port network.
10. To design Cascade Connection and determine ABCD parameters of the given two port network.
11. To design Series-Series Connection and determine Z parameters of the given two port network.
12. To design Parallel-Parallel Connection and determine Y parameters of the given two port network.
13. To design Series-Parallel Connection and determine h parameters of the given two port network.

Paper Code(s): EEC-255	L	P	C
Paper: Electrical Machines Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electrical Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To obtain magnetization characteristics of DC shunt generator and determine critical field resistance and critical speed.

2. To perform load test on DC shunt generator and determine the characteristics.

3. To perform speed control of DC shunt motor by field and armature control.

4. To perform the load test on D.C. shunt motor and to draw the performance characteristics.

5. To perform the Swinburne's test on a D.C. shunt Machine and to pre determine its efficiency when running as a motor as well as generator and also draw the characteristic curves.

6. To perform Open circuit and short circuit tests on single phase transformer for parameter estimation of the transformer.

7. To obtain star-star, star-delta and delta-delta connections for three phase transformers.

8. To perform parallel operation of two single phase transformers.

9. To perform block rotor test and no load test on induction motor(single phase) for parameter estimation.

10. To perform block rotor test and no load test on induction motor (three phase) for parameter estimation.

11. To perform SCC and OCC of an alternator and calculate voltage regulation at UPF, .8 leading and .8 lagging pf.

12. To perform load test on alternator.

Paper Code(s): ECC-265	L	P	C
Paper: Analog Electronics Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Analog Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & Calculate Static & Dynamic Resistance
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
   a) Half Wave Rectifier
   b) Centre Tapped Rectifier.
   c) Bridge Rectifier.
4. To Plot Input & Output characteristics CB/CE/CC transistor.
5. Plot the FET characteristics & MOSFET characteristics.
6. Two Stage R.C. Coupled Amplifier.
   a) To measure the overall gain of two stages at 1 KHz and compare it with gain ofIst stage,
   b) To observe the loading effect of second stage on the first stage.
   c) To plot the frequency response curve of two stage amplifier.
7. To study Emitter follower circuit & measurement of voltage gain and plotting of frequency response Curve.
8. Feedback in Amplifier. Single stage amplifier with and without by pass capacitor, measurement of voltage gain and plotting the frequency response in both cases.
9. To study the opamp (IC 741) as inverting and non inverting amplifier and calculate its gain.
10. To study the opamp (IC 741) as adder, sub-tractor and voltage follower, calculate its output voltage.
11. To study RC phase shift/WIEN BRIDGE oscillator
12. To study the waveform of square wave generator using 741 OP-AMP IC.

Paper Code(s): MEC-253	L	P	C
Paper: Theory of Machines Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Theory of Machines) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and verify the inversions of four bar (4R), single slider (3R-1P) crank and double slider (2R-2P) crank mechanism and also prove Grashof's Law.
2. To find out experimentally the Coriolis component of acceleration and compare with theoretical values
3. To study various types of CAM and follower mechanisms. Also, draw the CAM profile for the given CAM apparatus and determine jumping speed.
4. Draw velocity and acceleration diagram of engine mechanism using Klien's construction
5. To study various types of gear and gear trains and to determine gear ratio of simple, compound and epicyclic gear trains.
6. To calculate the torque on a Planet Carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
7. To determine the radius of gyration and moment of Inertia of a given rod.
8. To study and verify the motion of any one Governor.
9. To study and verify the gyroscopic law of motion.
10. To study and verify the dynamic balancing of rotating masses.
11. To determine the natural frequency of undamped free vibration of the given spring mass system.
12. To find the moment of inertia of a fly wheel.
13. To determine whirling speed of shaft theoretically and experimentally.

Paper Code(s): MEC-255	L	P	C
Paper: Strength of Materials Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Strength of Materials) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To perform the Hardness Test (Rockwell, Brinell & Vicker's test) and find the Hardness Number of different materials (MS, HSS, Wood, C.I., Al specimens).
2. To perform the Impact Test on a standard notched specimen to evaluate its Impact Number.
3. To perform the Tensile/Compression Test in ductile/brittle materials, draw a stress-strain curve and evaluate various mechanical properties of a given specimen.
4. To perform Shear Test and find maximum (ultimate) shear strength of given test specimen.
5. To perform the Bending /Deflection Test on a beam and evaluate its Young's Modulus.
6. To perform the Torsion Test and find modulus of rigidity, rupture stress (maximum shear stress), shear stress at yield point.
7. To determine Buckling loads of long columns with different end conditions.
8. To measure mechanical strain in a given beam using strain gauges.
9. To determine the different mechanical properties of given material under creep failure.
10. To determine flexural strength (modulus of rupture) of concrete beam.
11. To determine the endurance limit of the given specimen under fatigue or cyclic loading.
12. To find the Shear Modulus of two different materials; Aluminium and Steel using two twist and bent test rigs are used.
13. To determine the different mechanical properties of a given close coiled helical spring.

Paper Code(s): MEC-257	L	P	C
Paper: Thermal Engineering – I Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Thermal Engineering - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To draw the valve timing diagram of a Single Cylinder Four Stroke CI Engine.

2. To draw the valve timing diagram of a Single Cylinder Four Stroke SI Engine.

3. To determine Exergy destruction of Exhaust Gas Calorimeter of Petrol Engine test rig at different load.

4. To determine Exergy destruction of Exhaust Gas Calorimeter of Diesel Engine test rig at different load.

5. To determine the dryness fraction of given steam sample.

6. Visit and understanding of thermal power plant.

7. Thermodynamic analysis of Rankine cycle.

8. Comparative thermodynamic analysis of Otto, diesel and dual for the given condition.

9. Comparative analysis of air standard cycles under stated condition.

10. Study and analysis of Gas-Turbine cycle.

11. To study the working and construction different type of Boilers.

Paper Code(s): MEC-259	L	P	C
Paper: Manufacturing Science and Technology – I Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Manufacturing Science and Technology - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine the percentage of clay content in dry sand.
2. To determine the grain fineness number of a given sand specimen.
3. To Determine the moisture content quickly in fresh sand and moulding sand.
4. To determine the compressive strength of moulding sand.
5. To determine the permeability number of moulding sand.
6. Mould preparation and casting of metals after preparation of suitable moulds.
7. Laboratory experiments in fabrication processes using GMAW process.
8. Laboratory experiments in fabrication processes using Plasma Arc welding.
9. Laboratory experiments in fabrication processes using GTAW process.
10. Inspection of weld joints and welding defects.
11. Develop a flat blank layout, transfer the layout to the sheet metal, cut and form to the desired shape.
12. Practicing smithy or forging of carbon steels and testing of its property changes.
13. Form parts from metallic powders, record and plot pressing data, perform destructives tests on sintered powder metal parts.

Paper Code(s): CEC-253	L	P	C
Paper: Civil Engineering Drawing Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions for paper setter
1. The course objectives and course outcomes are given below.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more.

Course Objectives :

1.	To understand the basics of Civil Engineering.
2.	To use software(s) for development of civil engineering drawing.
3.	To calculate item/component quantity using software.
4.	To develop civil engineering drawing.

Course Outcomes (CO)

CO 1	To understand and draw the symbols and conventions in civil engineering drawing.
CO 2	To develop the building drawing for the given line plan and data.
CO 3	To draw the different types of staircases
CO 4	To measure the item quantities from the drawing.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	3	-	-	-	-	2	-	-
CO 2	-	-	-	-	3	-	-	-	-	2	-	-
CO 3	-	-	-	-	3	-	-	-	-	2	-	-
CO 4	-	-	-	-	3	-	-	-	-	-	2	-

UNIT-I

Symbols and conventions of materials: concrete, brickwork, glazing, wood, iron etc.

Symbols and conventions of building components- doors and windows; and fittings used in buildings: electrical, mechanical, plumbing and firefighting, sanitary etc.

UNIT-II

Double line plan, elevation, sectional elevation at different sections for a RCC framed and load bearing/ structure building

Structural detailing – beam, column, slab, foundation,

UNIT-III

Details of various staircases, perspective view of building/structure

UNIT – IV

Measurement of various item/component quantities- excavation, brickwork, concrete, plastering etc.

Text Books

1. Computer Aided design and Manufacture, Grover M.P.Simmers, E.W. Prentice Hall
2. CAD/CAM/CIM, Radhakrishnan & Subramanyam, Willey Eastern Limited Publications (Reprint 2015)

Reference Books

1. A Guide to the Preparation of Civil Engineering Drawings, M. V. Thomas, springer link
2. Civil Engineering Drawing & House Planning, Dr. B.P. Verma, Khanna Publishers

Paper Code(s): CEC-255	L	P	C
Paper: Fluid Mechanics Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Fluid Mechanics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To determine the pressure in a pipe line using various pressure measuring instruments.
2. To determine the metacentric height.
3. To verify the impulse momentum equation [impact of jet].
4. To verify Bernoulli's theorem using Bernoulli Instrument.
5. To determine cc, cv and cd of an orifice.
6. To calibrate a V- notch rectangular notch.
7. To calibrate a V- notch rectangular notch
8. To calibrate orifice meter.
9. To calibrate venturimeter.
10. To validate type of flow using Reynolds dye experiment.
11. Determination of frictional losses in pipes of different diameters.
12. Determination of minor losses in pipes.

Paper Code(s): CEC-257	L	P	C
Paper: Geomatics Engineering Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Geomatics Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of various instruments used in chain surveying.
2. To conduct the chain survey closed traverse around a building and plot the existing building.
3. To plot the plan of a given area by compass traversing
4. Study of theodolite in detail & measuring of horizontal angles by method of repetition
5. Locating given building by theodolite traversing.
6. Determination of elevation of various points with Auto level by collimation plane method and rise & fall method.
7. Determination of elevation of object if base of object accessible, using the principle of trigonometric levelling.
8. Determination of elevation of object if base of the object inaccessible and instrument stations in the same vertical plane as the elevated object
9. Determination of elevation of object if base of the object inaccessible and instrument stations not in same vertical plane as the elevated object, adopt trigonometrical levelling.
10. To study of various components of total station and measuring horizontal angle, vertical angle, horizontal distance and slope distance

11 To study about the stereoscope and determination of the line of flight on Aerial Photo.

12. Setting out a simple circular curve by different methods

Paper Code(s): ECC-263	L	P	C
Paper: Analog and Digital Electronics Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Analog and Digital Electronics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To plot V-I characteristics of a semiconductor diode & Calculate Static & Dynamic Resistance
2. To Study the Reverse characteristics of Zener diode
3. To Study the Rectifier circuit (With and Without Filter).
    a. Half Wave Rectifier
    b. Centre Tapped Rectifier.
    c. Bridge Rectifier.
4. To Plot Input & Output characteristics CB/CE/CC transistor.
5. Realization of basic gates.
6. Implementation of Boolean functions (two or three variables).
7. Realize all gates using NAND & NOR gates
8. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
9. Realize Master-Slave J K Flip-Flop, using NAND/NOR gates..
10. To study the opamp (IC 741) as inverting and non inverting amplifier and calculate its gain.
11. To study the opamp (IC 741) as adder, sub-tractor and voltage follower, calculate its output voltage.

Paper Code(s): BS-202	L	P	C
Paper: Probability, Statistics and Linear Programming	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for solving linear programming problems.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to formulate and solve linear programming problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	3	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.
Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

Unit II

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributions and Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.
Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the

Central Limit Theorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a Single Sample.

Unit III

Hypotheses Testing for a SingleSample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviationof a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference forTwo Samples.
Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR.

Unit IV

Linear Programming: Introduction, formulation of problem, Graphical method, Canonical and Standard form of LPP, Simplex method, Duality concept, Dual simplex method, Transportation and Assignment problem.

Textbooks:
1. *Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018
2. *Linear Programming* by G. Hadley, Narosa, 2002

References:

1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10^{th} Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.
6. *Operations Research: An Introduction* by Hamdy A. Taha, Pearson, 10th Edition, 2016

Paper Code(s): HS-204	L	P	C
Paper: Technical Writing	**2**	**-**	**2**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To improve grammar and sentence structure and build vocabulary.
2:	To understand how to write different types of writings.
3:	To understand how to compose different types of business documents.
4:	To understand business ethics and develop soft skills.

Course Outcomes (CO):

CO1:	Ability to improve grammar and sentence structure and build vocabulary.
CO2:	Ability to write different types of writings with clarity.
CO3:	Ability to write different types of business documents.
CO4:	Ability to apply business ethics and enhance personality.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	-	3	-	-
CO2	-	-	-	-	-	1	-	-	-	3	-	-
CO3	-	-	-	-	-	1	-	-	-	3	-	-
CO4	-	-	-	-	-	1	-	3	-	3	-	-

Unit I

Grammar and Vocabulary--- Types of sentences (simple, complex and compound) and use of connectives in sentences, Subject-verb agreement, Comprehension, Synonyms and Antonyms, Homophones and Homonyms, Word Formation: Prefixes and Suffixes, Indianism, Misappropriation and Redundant Words, Question Tags and Short Responses.

Unit II

Writing Styles -- Expository, Explanatory, Descriptive, Argumentative and Narrative.
Precis writing, Visual Aids in Technical Writing, Plagiarism and Language Sensitivity in Technical Writing, Dialogue Writing, Proposals: Purpose and Types.

Unit III

Letters at the Workplace—letter writing: Request, Sales, Enquiry, Order and Complaint.
Job Application---Resume and Cover letter, Difference between Resume and CV, Preparation for Interview.
Meeting Documentation--- Notice, Memorandum, Circular, Agenda, Office Order and Minutes of meeting, Writing Instructions.

Unit IV

Ethics and Personality Development-----The Role of Ethics in Business Communication—Ethical Principles, Time Management, Self-Analysis through SWOT and JOHARI Window, Emotional Intelligence and Leadership Skills, Team Building, Career Planning, Self Esteem.

Textbook:

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi (2015).

References:

1. Sanjay Kumar and Pushp Lata, Communication Skills, Oxford University Press, New Delhi (2015).
2. Herta A Murphy, Herbert W Hildebrandt, Jane P Thomas, Effective Business Communication, Tata McGraw-Hill, Hill Publishing Company Limited, Seventh Edition.

Paper Code(s): CIC-206	L	P	C
Paper: Theory of Computation	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand Automata (Deterministic and Non-Deterministic) and Language Theory
2.	To understand Context Free Grammar (CFG), Parse Trees and Push Down Automata
3.	To introduce the concepts of Turing Machines and Computability Theory
4.	To understand Complexity Theory (NP-completess NP-hardness) and Space complexity

Course Outcomes (CO)

CO 1	Ability to understand the design aspects of “abstract models” of computers like finite automata, pushdown automata, and Turing machines.
CO 2	Ability to comprehend the recognizability (decidability) of grammar (language) with specific characteristics through these abstract models.
CO 3	Ability to decide what makes some problems computationally hard and others easy?
CO 4	A ability to deliberate the problems that can be solved by computers and the ones that cannot?

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	1	1	3
CO 2	3	2	2	2	2	-	-	-	2	1	1	3
CO 3	3	2	2	2	2	-	-	-	2	1	1	3
CO 4	3	2	2	2	2	-	-	-	2	1	1	3

UNIT – I

Automata and Language Theory: Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Regular Expressions, Equivalence of DFAs, NFAs and Regular Expressions, Closure properties of Regular grammar, Non-Regular Languages, Pumping Lemma.

UNIT – II

Context Free Languages: Context Free Grammar (CFG), Parse Trees, Push Down Automata (deterministic and non-deterministic) (PDA), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma, Parsing, LL(K) grammar.

UNIT – III

Turing Machines and Computability Theory: Definition, design and extensions of Turing Machine, Equivalence of various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Reducibility and its use in proving undecidability. Rices theorem. Undecidability of Posts correspondence problem., Recursion

Theorem.

UNIT – IV

Complexity Theory: The class P as consensus class of tractable sets. Classes NP, co-NP. Polynomial time reductions. NP-completess, NP-hardness. Cook- Levin theorem (With proof). Space complexity, PSPACE and NPSPACE complexity classes, Savitch theorem (With proof). Probabilistic computation, BPP class. Interactive proof systems and IP class. relativized computation and oracles.

Textbook(s):

1. Sipser, Michael. Introduction to the Theory of Computation, Cengage Learning, 2012.
2. J. Hopcroft, R. Motwani, and J. Ullman, Introduction to Automata Theory, Language and Computation, Pearson, 2nd Ed, 2006.

References:

1. Peter Linz, An Introduction to Formal Languages and Automata, 6th edition, Viva Books, 2017
1. Maxim Mozgovoy, Algorithms, Languages, Automata, and Compilers, Jones and Bartlett, 2010.
2. D. Cohen, Introduction to Computer Theory, Wiley, N. York, 2nd Ed, 1996.
3. J. C. Martin, Introduction to Languages and the Theory of Computation, TMH, 2nd Ed. 2003.
4. K. L. Mishra and N. Chandrasekharan, Theory of Computer Science: Automata, Languages and Computation, PHI, 2006.
5. Anne Benoit, Yves Robert, Frédéric Vivien, A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis, CRC Press, 2013.

Paper Code(s): CIC-210	L	P	C
Paper: Database Management System	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts, architecture and characteristics of database systems
2.	To introduce relational model concepts and PL/SQL programming
3.	To introduce relational database design and Normal forms based on functional dependencies
4.	To introduce concepts of object oriented & distributed databases

Course Outcomes (CO) :

CO 1	Ability to understand advantages of database systems
CO 2	Ability to use SQL as DDL, DCL and DML
CO 3	Ability to design database and manage transaction processing
CO 4	Understand object oriented & distributed databases systems and use them

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT – I

Basic concepts: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, database languages & interfaces, data modelling using the entity-relationship approach. Enhanced ER concepts - Specialization/Generalization, Aggregation, Mapping of ER model to Relational Model.
SQL – DDL, DCL & DML views and indexes in SQL. Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator.

UNIT - II:

Relational model concepts, relational model constraints, relational algebra, relational calculus.
SQL – Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands – Commit, Rollback, Save point.

UNIT - III

Relational data base design: functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving decomposition, normal forms based on multivalued & join dependencies (4NF & 5NF) & domain key normal form

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures.
Database Programming – control structures, exception handling, stored procedures, Triggers.

UNIT - IV

File Structures and Indexing: Secondary Storage Devices, Operations on Files, Heap Files, Sorted Files, Hashing, Single level indexes, Multi-level indexes, B and B+ tree indexes.
Concepts of Object Oriented Database Management systems & Distributed Database Management Systems

Textbooks:

1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", Pearson Education, 7th Edition, 2018
2. V. M. Grippa and S. Kumichev, "Learning MySQL", O'Reilly, 2021.
3. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications

References:

1. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", McGraw Hill, 6th Edition,2013.
2. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
3. P. Rob & C. Coronel, "Database Systems: Design Implementation & Management", Thomson Learning, 6th Edition, 2004
4. Desai, B., "An introduction to database concepts", Galgotia publications, 2010
5. H. Garcia-Molina, J. D. Ullman, J. Widom, "Database System: The Complete Book", PH.
6. Joel Murach, Murach's Mysql"", 3rd Edition-Mike Murach and Associates, Incorporated, 2019.
7. Oracle and MySQL manuals.

Paper Code(s): CIC-212	L	P	C
Paper: Programming in Java	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and gain knowledge of characteristics of Java, JVM, instruction set, control flow, programming and the sandbox model.
2.	To learn the Java programming, use of exceptional handling and inheritance.
3.	To understand threads, thread synchronization, AWT components and event handling mechanism.
4.	To understand the concepts of I/O streams, JDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO)

CO 1	Ability to understand the compilation process of Java, role of JVM as an emulator and various types of instructions.
CO 2	Ability to learn and apply concepts of Java programming, exceptional handling and inheritance.
CO 3	Ability to understand the use of multi-threading, AWT components and event handling mechanism in Java.
CO 4	Ability to understand the concepts of I/O streams, IDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT - I

Overview and characteristics of Java, Java program Compilation and Execution Process Organization of the Java Virtual Machine, JVM as an interpreter and emulator, Instruction Set, class File Format, Verification, Class Area, Java Stack, Heap, Garbage Collection. Security Promises of the JVM, Security Architecture and Security Policy. Class loaders and security aspects, sandbox model

UNIT - II

Java Fundamentals, Data Types & Literals Variables, Wrapper Classes, Arrays, Arithmetic Operators, Logical Operators, Control of Flow, Classes and Instances, Class Member Modifiers Anonymous Inner Class Interfaces and Abstract Classes, inheritance, throw and throws clauses, user defined Exceptions, The String Buffer Class, tokenizer, applets, Life cycle of applet and Security concerns.

UNIT - III

Threads: Creating Threads, Thread Priority, Blocked States, Extending Thread Class, Runnable Interface, Starting Threads, Thread Synchronization, Synchronize Threads, Sync Code Block, Overriding Synced Methods, Thread Communication, wait, notify and notify all.
AWT Components, Component Class, Container Class, Layout Manager Interface Default Layouts, Insets and Dimensions, Border Layout, Flow Layout, Grid Layout, Card Layout Grid Bag Layout AWT Events, Event Models, Listeners, Class Listener, Adapters, Action Event Methods Focus Event Key Event, Mouse Events, Window Event

UNIT - IV

Input/Output Stream, Stream Filters, Buffered Streams, Data input and Output Stream, Print Stream Random Access File, JDBC (Database connectivity with MS-Access, Oracle, MS-SQL Server), Object serialization, Sockets, development of client Server applications, design of multithreaded server. Remote Method invocation, Java Native interfaces, Development of a JNI based application.
Collection API Interfaces, Vector, stack, Hashtable classes, enumerations, set, List, Map, Iterators.

Textbook(s):
1. Patrick Naughton and Herbertz Schidt, “Java-2 the Complete Reference”,TMH

References:
1. E. Balaguruswamy, “Programming with Java”, TMH
2. Horstmann, “Computing Concepts with Java 2 Essentials”, John Wiley.
3. Decker & Hirshfield, “Programming Java”, Vikas Publication.

Paper Code(s): EEC-206	L	P	C
Paper: Network Analysis and Synthesis	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To understand the LTI system and wave form synthesis.
2.	To understand mathematical modelling of circuit.
3.	To understand two port parameter and transfer function.
4.	To understand realization of passive network and filter.

Course Outcome (CO):

CO 1	Ability to determine function from waveform.
CO 2	Ability to determine transient respond of circuit.
CO 3	Ability to determine two port parameter of circuit.
CO 4	Ability to realize the circuit from their transfer function.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT-I

Introduction to signals, their classification and properties, different types of systems, LTI systems and their properties, periodic waveforms and signal synthesis, properties and applications of Laplace transform of complex waveform. [T1,T2]

UNIT-II

System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform. [T1,T2]

UNIT-III

Graph theory: concept of tree, tie set matrix, cut set matrix and application to solve electric networks.
Two port networks – Introduction of two port parameters and their interconversion, interconnection of two 2-port networks, open circuit and short circuit impedances and ABCD constants, relation between image impedances and short circuit and open circuit impedances. Network functions, their properties and concept of transform impedance, Hurwitz polynomial. [T1,T2]

UNIT IV

Positive real function and synthesis of LC, RC, RL Networks in Foster's I and II, Cauer's I& II forms, Introduction of passive filter and their classification, frequency response, characteristic impedance of low pass, high pass, Band Pass and Band reject prototype section. [T1,T2]

Textbook(s):

1. W H Hayt "Engineering Circuit Analysis" TMH Eighth Edition
2. Kuo, "Network analysis and synthesis" John Weily and Sons, 2nd Edition.

Reference Books:

1. S Salivahanan "Circuit Theory " Vikas Publishing House 1st Edition 2014
2. Van Valkenburg, " Network analysis" PHI, 2000.
3. Bhise, Chadda, Kulshreshtha, " Engineering network analysis and filter design" Umesh publication, 2000.
4. D. R. Choudhary, "Networks and Systems" New Age International, 1999
5. Allan H Robbins, W.C.Miller "Circuit Analysis theory and Practice"Cengage Learning Pub 5th Edition 2013
6. Bell "Electric Circuit" Oxford Publications 7th Edition.

Paper Code(s): ECC-210 / ECC-313	L	P	C
Paper: Microprocessors and Microcontrollers	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To impart knowledge about computer organization concepts so that students can understand basic computer organization and design
2.	To impart knowledge about architecture and instruction set of 8085 microprocessor so that students can implement 8085 assembly language programs.
3.	To impart knowledge about interfacing of memory devices, data convertors and simple I/O devices with 8085 microprocessor.
4.	To impart knowledge about architecture and operation of Programmable Peripheral Devices and their interfacing with 8085 microprocessor.

Course Outcome (CO):

CO 1	Understand computer organization concepts and describe evolution of Microprocessor technology.
CO 2	Ability to understand and distinguish the use of different 8085 instructions and apply those instructions for implementing assembly language programs.
CO 3	Understand and realize the interfacing of memory devices, data convertors and simple I/O devices with 8085 microprocessor.
CO 4	Understand the architecture and operation of Programmable Peripheral Devices and ability to use them for interfacing I/O devices.

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	-	-	-	-	-	-	-	1
CO 2	3	3	3	2	3	-	1	-	2	-	2	-
CO 3	3	3	3	2	3	-	-	-	-	-	-	-
CO 4	3	3	3	2	3	-	-	-	-	-	-	-

UNIT - I

Computer Organization concepts: Stored Program Organization, Computer Registers, Machine language instructions, addressing modes, Instruction formats, Arithmetic Logic Unit, Data path, Design of Control Unit, Instruction pipelining concepts.
Introduction to microprocessors – Single Chip CPU, Microprocessors Evolution, Trends in Microprocessor Technology.

UNIT – II

Study 8-bit microprocessor8085-Architecture and Programming Model of 8085 Microprocessor, PIN Layout and description of Signals, Power supply requirements and system clock, Basic Interfacing Concepts, Memory mapped I/O, Instruction Set of 8085, Data transfer, Arithmetic, Logical and branch instructions, Format of 8085 machine instructions, Instruction Execution and Timing diagram, Example of an 8085 – based microcomputer board.

Assembly Language Programming of 8085- Counters and Time delays, Stacks and Subroutines, Code Conversion, BCD Arithmetic, implementing 16-bit operations on 8-bit microprocessor, implementing 8085 programs using a single board computer, writing programs using an assembler

UNIT – III

Methods of Data Transfer and Interrupt Structure of 8085- Data transfer mechanisms, Memory mapped and I/O mapped data transfer, Programmed data transfer, Parallel data transfer, Serial data transfer, RS-232 standard, RS-485 standard, GPIB/IEEE 488 standard, Interrupt driven data transfer, Interrupt Structure of 8085, RST instructions, Multiple interrupts and priorities, 8085 vectored interrupts, Direct Memory access concepts.

Interfacing of Memory devices with 8085-Generation of control signals for memory, Interfacing EPROM and RAM chips with 8085

Interfacing data converters with 8085-Interfacing 8-bit D/A and 8-bit A/D converters with 8085 using status check and interrupts.

UNIT – IV

Programmable peripheral devices and their Interfacing with 8085- 8255 programmable peripheral interface, operating modes, control words, Interfacing switches and LEDs, Interfacing A/D and D/A using 8255, Waveform generation, 8279 Keyboard and display controller, Interfacing seven segment displays and matrix keyboards, 8254 Programmable Interval Timer, 8259 Programmable Interrupt Controller, 8237 DMA Controller. Serial I/O and Data Communication, Asynchronous Serial I/O, Hardware Controlled Serial I/O using 8251

Textbook(s):

1. Ramesh Gaonkar, Microprocessor Architecture, Programming, and application with 8085, Sixth Edition, Penram International Publication, 2013.

References:

1. John Ufferbeck, Microcomputers and Microprocessors, Third Edition, PHI, 2000.
2. Barry B. Brey, Intel Microprocessors, 8th Edition, Pearson Education/Prentice Hall ,2009
3. J. L. Antonakos, “An Introduction to the Intel Family of Microprocessors”, Thomson, 1996.

Paper Code(s): ECC-212	**L**	**P**	**C**
Paper: Digital Communications	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To understand importance of information theory in digital communication and various PCM modulation.
2.	To understand the variance basic concepts of digital communication.
3.	To understand the various digital Modulation-demodulation techniques
4.	To understand various coding in digital communications.

Course Outcome (CO):

CO 1	Ability to understand the channel information carrying capacity and conversion of analog to digital signals.
CO 2	Ability to understand the effect of additive white Gaussian Noise on digital communication modulation techniques.
CO 3	Ability to analyse the effect of inter symbol interference as the source of channel impairment and the effect of multipath phenomenon.
CO 4	Ability to use and design communication systems for reliable communication

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT I

Review of probability theory and Stochastic processes, Poisson and Gaussian Process, Noise, Narrowband Noise, Sinewave plus Narrowband Noise. Information Theory: Entropy, Source Coding Theorem, Lossless data compression, Discrete Memoryless channel, Mutual Information, Channel Capacity, Channel Coding Theorem, Differential Entropy and Mutual Information for Continuous Random Ensembles, Information Capacity Law. Sampling Theory, PAM, Quantization characteristics, PCM, DPCM, Delta Modulation, Line Codes.

UNIT II

AWGN Channel Signalling: Geometric Representation of Signals, Conversion of Continuous AWGN Channel to a vector channel, : ASK, QASK, FSK, M-array FSK, BPSK, DPSK, DEPSK, QPSK, M-array PSK, QAM, MSK, GMSK, Coherent and non-coherent detection and other keying techniques.

UNIT III

Band Limited Channels: Error rate due to channel noise in a matched filer receiver, Intersymbol Interference, Signal Design for Zero ISI, Ideal Nyquist Pulse for Distortionless Baseband data transmission, Raised cosie and square root raised cosine spectrum, Eye pattern, Adaptive equalization, signalling over multiple baseband channel, Digital Subscriber Lines.
Fading Channels: Propagation effects, Jakes Model, Statistical Characteristics of wideband wireless channel, FIR modelling of doubly spread channel, Effects of flat fading, Diversity techniques, MIMO, MIMI Capacity for channel known at receiver, OFDM, Spread-spectrum signals, CDMA, Rake receiver and Multipath Diversity

UNIT IV

Error Control Coding: Introduction, Error Control using forward correction, Discrete Memory less channel, Linear Block Code, Cyclic Codes, Convolutional Codes, Optimum Decoding of Convolutional Codes

Textbook(s):

1. Simon Haykins, “Digital Communication Systems” John Wiley, 2014

References:

1. Simon Haykins and Michael Moher, “Communication Systems” John Wiley &sons Inc, 5th edition, 2009.
2. B P Lathi and Zhi Ding, “Modern Digital and Analog Communication Systems”, OUP, 5th edition, 2019
3. H P Hsu, Schaum Outline Series, Analog and Digital Communications, TMH 2006
4. J.G Proakis, Digital Communication, 4th Edition, Tata Mc Graw Hill Company, 2001.

Paper Code(s): ECC-214	L	P	C
Paper: Analog Electronics – II	**3**	**-**	**3**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1.	To understand Basic building block and characteristic of Op-Amp
2.	To understand the frequency response and Configurations of Op-Amp
3.	To analyze and design linear, nonlinear and Oscillators circuits using Op-Amp
4.	To analyze and design active filters and to understand function of Op-Amp based special ICs

Course Outcome (CO):

CO 1	Ability to understand and use Op-Amps to design open-loop and closed loop configuration.
CO 2	Ability to analyse frequency response of and Op-Amp circuit.
CO 3	Ability to use Op-Amp in linear and non-linear applications.
CO 4	Ability to design Active Filters

Course Outcomes (CO) to Programme Outcomes (PO) Mapping (Scale - 1: Low, 2: medium, 3: High)

CO/PO	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT – I

The Operational Amplifiers: Block diagram representation of OP-AMP; Evolution of IC and types, Power supply for Op-Amp; The Ideal Op-Amp: schematic, characteristics, equivalent circuit, Ideal voltage transfer curve, typical IC 741 characteristics

Open Loop Op-Amp configurations: The differential amplifier, inverting amplifier, non-inverting amplifier

Closed loop Op-Amp configurations: inverting and non-inverting amplifiers, voltage followers, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, Inverting and Non-Inverting op-amp.

UNIT – II

The Practical Op-Amp: Input offset voltage, input bias current, input offset current, Total output offset voltage, thermal drift, error voltage, Supply voltage rejection ration (SVRR), CMRR

Frequency Response of An Op-Amp: Frequency response compensator networks, High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency, Slew rate, causes of slew rates and its effects in application.

UNIT – III

Linear applications of Op-Amps: Summing, scaling and averaging amplifier (inverting, non-inverting & differential configuration), voltage to current & current to voltage converters, Integrator, Differentiator,
Non-Linear applications of IC op-amps: Comparator, Zero crossing detector, Schmitt Trigger, Clipping & Clamping Circuits, Precision Rectifiers, sample and hold circuit
Oscillators: Principles & Types; Phase shift, Wein-bridge & quadrature. Square wave, triangular wave and saw tooth wave generators, voltage-controlled oscillator

UNIT – IV

Active Filters: Classification and frequency response of filters, response Advantages of active filters, characteristics of butter worth, chebyshev, first order and second order butter worth filters- low pass and high pass types. Band pass & band reject filters.
Specialised IC- The 555 Timer: functional diagram, Monostable and Astable multivibrators; PLL: Basic PLL principle, monolithic 565 PLL; Voltage Regulators, Three terminal IC voltage regulators(LM 317

Textbook(s):

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.
2. D. Roy Choudhary & S. B Jain, "Linear Integrated Circuit", 2nd ed. New age publication.2018.

References:

1. Adel S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits Theory and Applications," 5th Edition , OUP, 2004.
2. David A. Bell, "Op-amp & Linear ICs", Oxford, 2013.
3. James M. Fiore, "Op Amps & Linear Integrated Circuits Concepts & Applications", Cengage, 2010.
4. J. Michel Jacob, "Applications and Design with Analog Integrated Circuits", PHI, 2004.
5. R. L. Boylestad and N. Nashlesky, "Electronic Devices and Circuit Theory", Pearson Education, 11th Ed., 2014
6. J. Millman, C. Halkias, and C. D. Parikh, "Millman's Integrated Electronics: Analog and Digital circuits and system", McGraw Hill Education, 2018.

Paper Code(s): EEC-210	L	P	C
Paper: Electrical Machines – II	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concept of synchronous generator.
2.	To understand the concept of three phase induction motor.
3.	To understand the concept of synchronous motor.
4.	To understand the concept of single phase motor.

Course Outcomes (CO)

CO 1	Ability to analyse the synchronous generator.
CO 2	Ability to analyse ofthree phase induction motor
CO 3	Ability to analyse ofsynchronous motor.
CO 4	Ability to analyse ofsingle phase motor.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

Unit I

Synchronous Alternators Constructional features, armature windings, E.M.F. equation, winding coefficients, harmonics in the induced E.M.F., armature reaction, O.C. and S.C. tests, voltage regulation-Synchronous impedance method, MMF Method, Potier's triangle method parallel operation, operation on infinite bus, cooling. Two reaction theory, power expressions for cylindrical and salient pole machines, performance characteristics. [T1,T2]

Unit II

Poly phase Induction Machines Constructional features, production of rotating magnetic field, working of 3-phase Induction motor, phasor diagram, equivalent circuit, power and torque relations, torque and slip relations, no load and blocked rotor tests and efficiency. speed control by rotor resistance, injected e.m.f, frequency variation and pole changing, DOL, Y-Δ and autotransformer starters, deep bar and double cage rotor motors, cogging and crawling, operation of Induction machine as generator and phasor diagram. [T1,T2]

Unit III

Synchronous Motors – Principle of operation, starting methods, phasor diagram torque-angle characteristics, V-curves hunting and damping, synchronous condenser, introduction to single phase synchronous motors: Reluctance and Hysteresis motors. [T1,T2]

Unit IV

Fractional Horse Power Motors Single Phase Induction Motor: Double revolving field theory, equivalent circuit, no load and blocked rotor tests, starting methods, split phase Induction motor- capacitor start, two value capacitor motor.
Introduction and applications of single phase AC series motor, universal motor, AC servo motor, stepper motor, permanent magnet AC motors. [T1,T2]

Textbook(s):

1. A Fitzgeral, Charles Kingsley, Stephen Umans, “Electric Machinery”, Tata McGraw Hill Education, 6th Edition, 2002
2. I J Nagrath D P Kothari, “Electric Machines”, McGraw-Hill Education, 3rd edition, 2011.

Reference Books:

1. The Performance and Design of Alternating Current Machines, M.G. Say, CBS Publishers, 2005
2. Oblems in Electrical Engineering: Power engineering and electronics with answers Partly Solved in I. Units: Parker Smith , CBS Publishers, 9th edition, 2003
3. Electric Machines, I J Nagrath D P Kothari, Mc Graw-Hill Education, 3rd edition, 2011
4. Samarjit Ghosh, “Electrical Machines”, Pearson

Paper Code(s): EEC-212	L	P	C
Paper: Power Systems – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of transmission line parameter.
2.	To impart the knowledge of transmission line.
3.	To impart the knowledge of cables.
4.	To impart the knowledge of load flow studies.

Course Outcomes (CO)

CO 1	Ability to calculate the transmission line parameters.
CO 2	Ability to analyse performance of transmission line.
CO 3	Ability to understand working of cables.
CO 4	Ability to solve load flow in power system.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

UNIT I

Power System Components: Block diagram of electric power system, Single line diagram of power system, brief description of power system elements such as, synchronous machine, transformer, transmission line, bus bar and circuit breaker.
Transmission line: Configurations, type of conductors, Mechanical Design of Transmission Line: catenary curve, calculation of sag and tension, effects of wind and ice loadings on sag, sag template, vibration dampers. Overhead Lines Insulators: Types of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential. [T1,T2]

UNIT II

Overhead Transmission Lines: Corona and Interference: Phenomenon of corona, corona loss, factors affecting corona, methods of reducing corona, bundle conductors and interference.
Calculation of resistance (skin & proximity effects), inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines. Modeling and performance analysis of short, medium and long transmission line. Ferranti effect, Transposition of transmission conductors, surge impedance loading. Introduction and analysis of travelling wave use of Bewley Diagram. [T1,T2]

UNIT III

Insulated Cables: Types of cables, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables.
Fault Analysis: Per unit system, symmetrical component, calculation of symmetrical and unsymmetrical fault, use of current limiting reactors. [T1,T2]

UNIT IV

Power Flow Analysis: Formulation of Y-bus Matrix, Power flow equations, Classification of buses, Data for load flow, Gauss-Seidal Method, acceleration factor of convergence; Newton Raphson Method Fast Decoupled load flow; Comparison of power Flow Methods. [T1,T2]

Textbook(s):

1. C.L.Wadhava, "Electrical Power Systems", New Age International, 2004
2. Hadi Saddat, "Electric power systems", Tata McGraw Hill. 2014.

Reference Books:

1. S. L. Uppal, "Electrical Power", Khanna Publishers, 13th edition 2003
2. W. H. Stevension, "Elements of Power System Analysis", McGraw Hill, 1982
3. Ashfaq Hussain, "Electrical Power System" CBS Publishers and Distributors.

Paper Code(s): ECC-218	L	P	C
Paper: Electronics – II	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the working of amplifier circuits.
2.	To understand the working of multi-stage, feedback and power amplifier.
3.	To understand working of operational amplifier and linear applications.
4.	To understand the function of waveform generators.

Course Outcomes (CO)

CO 1	Ability to solve problems related to amplifier circuits.
CO 2	Ability to apply the amplifiers circuits in real world.
CO 3	Ability to analyse various operational amplifier circuits.
CO 4	Ability to understand the function of various waveform generators.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**

UNIT – I

BJT, FET MOSFET Bias stabilization: Need for stabilization, fixed Bias, emitter bias, self-bias, bias stability with respect to variations in ICO, Small signal amplifiers:, hybrid model for transistor at low frequencies, RC coupled amplifiers, mid band model, gain & impedance, comparisons of different configurations, Emitter follower, Darlington pair(derive voltage gain, current gain, input and output impedance). [T1]

UNIT – II

Multistage Amplifiers
Feedback Amplifiers: Feedback concept, Classification of Feedback amplifiers, Properties of negative Feedback amplifiers, Impedance considerations in different Configurations,
Power Amplifiers: Power dissipations in transistors, Amplifiers Classification, (Class-A, Class-B, Class-C, Class-AB) Efficiency analysis, Push-pull and complementary Push-pull amplifiers. [T1]

UNIT – III

Linear & Non Linear Wave shaping: , Inverting and non-inverting amplifiers, voltage follower, difference amp, adders, Voltage to current with floating & grounded load, current to voltage converter, practical integrator & differentiator, Clipping & Clamping circuits, Comparators, log/antilog circuits using Op-Amps, precision

rectifiers(half & full wave),peak detector, Inverting & non inverting Schmitt trigger circuit.
Waveform generations: Sine wave generator (Phase shift, Wein bridge, Hartley & Colpitts), Barkhausen criteria of oscillations, conditions for oscillation, crystal oscillator. [T2]

UNIT IV

Waveform generators: Square and triangular waveform generators (determine period and frequency), saw tooth wave generator, Astable multi-vibrator, Monostable and Bistable Multivibrator.
Active RC Filters: Idealistic & Realistic response of filters (LPF, BPF, HPF, BRF), Butter worth & Chebyshev approximation filter functions All pass, Notch Filter. [T2]

Textbook(s):

1. Salivahanan , Suresh Kumar, Vallavaraj, “Electronic Devices and Circuits” TMH, 1999
2. D. Roy Choudhary, Shail B Jain, “Linear Integrated Circuits” New Age Publisher, 1999.

Reference Books:

1. B. Kumar ,Shail Bala Jain, “Electronic Devices and Circuits” PHI.
2. M.Rashid , “Microelectronic Circuit”, Cengage Learning Publication.
3. Sedra & Smith, “Micro Electronic Circuits” Oxford University Press, 2000
4. David A Bell, “Operational Amplifiers and Linear IC’s”, PHI.

Paper Code(s): ECC-206	L	P	C
Paper: Communication Systems	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand working of general instrument system, types of error, methods of measurement etc.
2.	To give an overview of test and measuring instruments.
3.	To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance.
4.	Understand the principle and working of various electrical and electronic measuring instruments

Course Outcomes (CO)

CO 1	Ability to understand principal and working of electric and electronic measuring instruments
CO 2	Ability to analyse various errors in measurement
CO 3	Ability to evaluate the unknown quantities using measuring instruments
CO 4	Ability to design bridge circuits for measurement of resistance, capacitance and inductance

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	2	2	1	2	1	-	2	2	-	3
CO 2	3	3	2	2	1	2	1	-	2	2	-	2
CO 3	2	2	1	2	1	2	1	-	2	2	-	2
CO 4	2	2	2	2	1	2	1	-	2	2	-	2

UNIT I

Introduction: Overview of Communication system, Communication channels, Mathematical Models for Communication Channels
Introduction of random Variables: Definition of random variables, PDF, CDF and its properties, joint PDF, CDF, Marginalized PDF, CDF, WSS wide stationery, strict sense stationery, non-stationery signals, UDF, GDF, RDF, Binomial distribution, White process, Poisson process, Wiener process. [T1, T2]

UNIT II

Analog Modulation: Modulation- Need for Modulation, Amplitude Modulation theory: DSB-SC, SSB, VSB. Modulators and Demodulators. Angle Modulation, Relation between FM and PM Wave. Generation of FM wave- Direct and Indirect Methods. Bandwidth of FM (NBFM, WBFM)
Pulse Analog Modulation: Sampling-Natural and Flat top. reconstruction, TDM-Pulse Amplitude Modulation (TDM-PAM), Pulse Width Modulation (PWM), Pulse Position Modulation(PPM), Generation and Recovery.
Pulse Digital Modulation: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), ADPCM. [T1, T2]

UNIT III

Digital Modulation and Transmission: Advantages of digital communication. Modulation schemes: ASK, PSK, FSK. Spectral Analysis. Comparison. Digital Signaling Formats-Line coding.
Information and Coding Theory: Entropy, Information, Channel Capacity. Source Coding Theorem: Shannon Fano Coding, Huffman Coding. [T1, T2]

UNIT IV

Fiber Optical System: Basic Optical Communication System. Optical fibers versus metallic cables, Light propagation through optical fibers. Acceptance angle and acceptance cone, Fiber configurations. Losses in optical fibers. Introduction to Lasers and light detectors. Applications: Military, Civil and Industrial applications.
Advanced Communication Systems: Introduction to cellular radio telephones. Introduction to satellite Communication. [T1, T2]

Textbook(s):

1. George Kennedy, "Electronics Communication System", TMH 1993.
2. B.P. Lathi, "Analog& Digital Communication", Oxford University Press 1999.

Reference Books:

1. Simon Haykin, "Introduction to Analog & Digital Communication", Wiley, 2000
2. Tannenbaum, "Computer networks", Pearson, 5th Edition.
3. K. Sam Shanmugam, "Digital & Analog Communication system", John Wiley & Sons 1998

Paper Code(s): ECC-208	L	P	C
Paper: Digital Electronics	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1^{st}) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the knowledge of codes and switching functions in digital electronics.
2.	To understand working of combinational logic circuits.
3.	To impart the knowledge of sequential logic circuits.
4.	To understand the applications of 555 timer and A to D and D to A converters.

Course Outcomes (CO)

CO 1	Ability to understand conversion of codes and switching operations.
CO 2	Ability to design combinational logic circuits using gates.
CO 3	Ability to analyse sequential logic circuits.
CO 4	Ability to understand applications of 555 timer and A to D and D to A converters.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	2	1	1	-	2	1	-	2
CO 2	3	3	3	3	2	1	1	-	2	1	-	2
CO 3	3	3	3	3	2	1	1	-	2	1	-	2
CO 4	3	3	3	3	2	1	1	-	2	1	-	2

UNIT I

Number Systems and Codes:- Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.
Switching Theory: - Boolean Algebra- Postulates and Theorems, De' Morgan's Theorem, Switching Functions- Canonical Forms- Simplification of Switching Functions- Karnaugh Map and Quine Mc-Clusky Methods. .

[T1,T2]

UNIT II

Combinational Logic Circuits:- Review of basic gates- Universal gates, Adder, Subtractor ,Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL.
Integrated circuits: - TTL and CMOS logic families and their characteristics. Brief introduction to RAM and ROM.

[T1,T2]

UNIT III

Sequential Logic Circuits: - Latches and Flip Flops- SR, , D, T and MS-JK Flip Flops, Asynchronous Inputs.
Counters and Shift Registers:- Design of Synchronous and Asynchronous Counters:- Binary, BCD, Decade and Up/Down Counters , Shift Registers, Types of Shift Registers, Counters using Shift Registers- Ring Counter and

Johnson Counter, Sample and Hold Circuit. [T1,T2]

UNIT IV

Introduction to 555 Timer IC: Functional and block diagram of 555 timer, Application of 555 timer as astable and monostable multivibrator.
Analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time). [T1,T2]

Textbook(s):

1. Zyi Kohavi, "Switching & Finite Automata Theory", TMH, 2nd Edition
2. Morris Mano, Digital Logic and Computer Design", Pearson

Reference Books:

1. A Anand Kumar, "Fundamentals of Digital Logic Circuits", PHI
2. Taub ,Helbert and Schilling, "Digital Integrated Electronics", TMH

Paper Code(s): ICC-210	**L**	**P**	**C**
Paper: Sensors and Transducers	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To provide an understanding about the concepts of measurement system its static and dynamic characteristics.
2.	To expose the students to various sensors and transducers for measuring mechanical quantities and their applications.
3.	To teach the basic conditioning circuits for various sensors and transducers.
4.	To introduce about advancements in sensor technology and smart sensors.

Course Outcomes (CO)

CO 1	Ability to define, understand various Sensors, their need and properties of sensors.
CO 2	Ability to apply knowledge of various types of transducers in domestic and industrial applications
CO 3	Ability to analyse various types of sensors for particular application.
CO 4	Ability to design signal conditioning circuit for various sensors and transducers.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	1	1	1	1	-	1	3	-	3
CO 2	3	2	1	3	2	1	1	-	1	3	-	1
CO 3	3	2	1	2	3	1	1	-	1	3	-	3
CO 4	3	3	2	1	1	1	1	-	1	3	-	3

UNIT I

[Introduction to sensors and Transducers] General concepts and terminology of measurement systems and its functional elements, transducer classification, static and dynamic characteristics of a measurement system, criteria for transducer selection.
Resistive Transducers: Principles of operation, construction, theory, signal conditioning circuits and applications of resistance potentiometers, strain gauges (metallic and semi-conductor type), resistance thermometer, thermistors, photo transistors. [T1,T2]

UNIT II

[Displacement Sensors and Transducers] Capacitive Transducers: Types of capacitive transducer, Principles of operation, construction, theory, signal conditioning circuits and applications of capacitive transducers
Inductive Transducers: Types of Inductive transducer, Principles of operation, construction, signal conditioning circuits and applications of various variable inductive transducers, LVDT , RVDT Eddy current sensors, Synchros. [T1,T2]

UNIT III

[Temperature and Radiation Sensors] Active Transducers: Principle of operation, construction, theory, signal conditioning and applications of Piezo-electric transducer, Magneto-strictive transducer, Hall effect transducer, Photo-voltaic transducer and Thermocouple
Optical transducers: photo-emissive, photo-conductive and Photovoltaic cells, photomultipliers
Digital Transducers: Optical encoders translational and rotary encoders (absolute position and incremental position encoders) and magnetic pickups. [T1,T2]

UNIT IV
[Smart Sensors] Other transducers: Ultrasonic sensors, Vibration pickups and accelerometers and its dynamic response, stroboscope, sound and humidity sensors Microelectromechanical. system (MEMS), Biosensors: Glucometer, Oxymeter, Nanosensors and its application, Smart sensor system. [T1,T2]

Textbook(s):
1. D. Patranabis, —Sensors and Transducers‖, PHI Learning Pvt. Ltd., 2nd edition.
2. D V S Murty, —Transducers and Instrumentation‖, PHI Learning Pvt. Ltd.

Reference Books:
1. E.O. Doebelin,Dhanesh N Manik, —Measurement Systems‖,6th Edition, McGraw Hill Edu.
2. John P. Bentely, —Principles of Measurement System‖, 4th Edition, Pearson Prentice Hal .

Paper Code(s): EEC-214	L	P	C
Paper: Electrical and Electronics Measurements	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand working of general instrument system, types of error, methods of measurement.
2.	To give an overview of test and measuring instruments.
3.	To expose the students to the design of bridges for the measurement of resistance, capacitance and inductance.
4.	Understand the principle and working of various electrical and electronic measuring instruments

Course Outcomes (CO)

CO 1	Ability to understand principal and working of electric and electronic measuring instruments
CO 2	Ability to analyse various errors in measurement
CO 3	Ability to evaluate the unknown quantities using measuring instruments
CO 4	Ability to design bridge circuits for measurement of resistance, capacitance and inductance

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	-	-	-	-	-	-	-	-	3
CO 2	3	3	-	-	-	-	-	-	-	-	-	3
CO 3	3	3	2	3	-	-	-	-	-	2	-	3
CO 4	3	3	3	3	-	2	2	-	2	2	-	3

UNIT I

Basics of Measurement: Measurement & its significance, Direct & Indirect methods of measurement, classification of measurement
Characteristics of Measurement: Static and dynamic characteristics
Units & Standards: SI units, standards of Measurement (R, L, C, Voltage, current & frequency)
Errors in Measurement: types of errors in measurement system, Error and Uncertainty analysis, Propagation of errors, Linear and weighted regression. [T1,T2]

UNIT II

AC Bridges: Wheatstone bridge, kelvin double bridge, Maxwell bridge, Megohm bridge, Anderson bridge, Schering and Wein's bridge for measurement of R, L, C and frequency respectively. Q meter, Shielding and grounding. [T1,T2]

UNIT III

AC Instruments: Measurement of voltage, current and power in single phase and three phase circuits, ac and dc current probes, true rms meter, voltage and current scaling.

Instrument Transformers: Construction, operation & ratio and phase errors in current and potential transformers, compensation technique for error in current and potential transformers. [T1,T2]

UNIT IV

Electronic Measuring Instruments: General purpose cathode ray oscilloscope (CRO); Construction & working & principleTimer/counter, Measurement of time, phase& frequency, digital voltmeter, digital multimeter. [T1,T2]

Textbook(s):

1. Albert D.Helfrick, William D.Cooper, ―Modern Electronic Instrumentation and Measurement Techniques‖, PHI India.
2. Electronic Instrumentation by HS Kalsi, Tata McGraw- Hill.

Reference Books:

1. A.K. Sawhney, Puneet Sawhney – A course in Electrical and Electronic Measurements and Instrumentation.
2. J.B GUPTA – A courseinElectrical and Electronic Measurements and Instrumentation.
3. B. C. Nakra., K. K. Chaudhry, ―Instrumentation, Measurement and Analysis, 4th Edition, McGraw Hill Education.
4. Electrical Measurements & Measuring Instruments by Golding & Widdis, Wheeler's.

Paper Code(s): MEC-206	L	P	C
Paper: Manufacturing Science & Technology - II	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of metal cutting and tool materials.
2.	To develop an understanding of the various machine tools.
3.	To introduce students to different gear forming methods and jigs & fixtures
4.	To acquire a fundamental knowledge on non-traditional machining processes.

Course Outcomes (CO)

CO 1	Understand and apply concepts of cutting tool geometry, materials, mechanism of chip formation and mechanics of metal cutting
CO 2	Illustrate and identify the various constructional features and operations performed on machine tools.
CO 3	Analyse the kinematic motions and associated mathematical relationships in a machine tool.
CO 4	Select a machine tool, cutting tool and holding devices as per the requirement of metal cutting and submit report in a team.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	-	3	-	2	-	-	-	-	-	-
CO 2	3	-	2	-	-	2	-	-	-	-	-	-
CO 3	3	3	2	2	-	2	-	-	-	-	-	-
CO 4	3	2	2	3	-	2	-	-	3	3	-	-

UNIT-I

Theory of Metal Cutting: Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation, Types of Chips. Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation.

Cutting Tool Materials: Desired properties and types of cutting tool materials, Cutting fluids and its desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool, work piece and chip. Measurement of tool tip temperature.

UNIT-II

Lathe, Shaper, Planer and Slotter: Classification, constructional features, work and tool holding devices for General lathe, Turret and Capstan Lathe. Tool Layout, shaping Machine, Planing Machine, Driving mechanisms of lathe, shaping and planing machine tools, Different operations on lathe, shaping machine, planing, slotting machine tools. Problems on machining time calculations, thread cutting.

Drilling: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, Basic principle of design of drill bits, drill materials, related problems.

UNIT-III

Milling and Grinding: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations. Indexing Methods: Simple and compound. Problems on indexing and machining time calculation. Grinding: Selection of grinding wheel, Classification, constructional features of grinding machines (Centerless, cylindrical and surface grinding), Dressing and truing of grinding wheels.

Broaching process: Principle of broaching, Applications, advantages and limitations. Finishing and other Processes Lapping and Honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

Gear Manufacturing: Gear forming, gear generation, gear shaping and gear hobbing.

UNIT - IV

Jigs & Fixtures: Important considerations in jigs and fixture design. Main principles of designing of jigs & fixtures, elements of Jigs and fixtures. Different devices and methods of locations. Different types of clamps used in jigs & fixtures.

Introduction to CNC machines- Principles of operation. Basics of Manual part programming methods.

Non- Traditional Machining: Need and classification of non-traditional machining, Principle, equipment & operation of Electric discharge machining, Laser Beam Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining.

Textbook(s):

1. B.L. Juneja, G. S. Sekhon, Nitin Seth, “Fundamental of Metal Cutting and Machine Tools”, New Age International; 2nded.
2. A. Ghosh and A.K. Mallik, “Manufacturing Science”, East West Press.
3. P. H. Joshi, “Jigs and Fixtures”, Tata McGraw Hill;2nd ed.

References:

1. G. Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, Taylor and Francis; 3rd ed.
2. M. C. Shaw, “Metal Cutting Principles”, Oxford University Press.
3. J.A. McGeough, “Advanced Methods of Machining”, Springer International Edition.
4. P.C. Sharma, “A Text Book of Production Engineering”, S. Chand, New Delhi;(2004)
5. H. S. Bawa, “Workshop Technology”, Vol.2, Tata McGraw Hill;(2004)
6. G.K. Lal, “Introduction to Machining Science”, New age International.
7. A. Bhattacharya,Metal cutting Theory and Practice- New Central Book Agency.

Paper Code(s): MEC-208	L	P	C
Paper: Material Science and Metallurgy	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To develop the knowledge of lattice structure and their defects.
2.	To develop the relation between structural and mechanical properties of metals for the selection of product design.
3.	Identify the microstructure and properties of Iron-Iron carbide Phase diagram.
4.	To develop the knowledge of various composite materials and their applications.

Course Outcomes (CO)

After completion of the course, the students will be able to:

CO 1	Summarize the properties of crystal structures of metallic elements and understand the mechanism of diffusion and deformation.
CO 2	To relate the material behaviour under environmental conditions and interpret the characteristics of steel through iron- iron carbide and TTT diagram.
CO 3	Relate the properties of steel with heat treatment processes and study the effect of alloying elements in steel.
CO 4	Classify types of corrosion and composites.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (Scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	1	3	2	-	-	-	-	-	-	3	3
CO 2	3	2	3	2	-	-	-	-	-	-	3	3
CO 3	3	2	3	2	-	-	-	-	-	-	3	3
CO 4	3	-	-	2	-	3	3	-	-	-	3	3

UNIT – I

Structure of metal: Crystal structure (BCC, FCC and HCP), Packing factor and density calculation, miller indices, imperfections in solids.

Diffusion: Diffusion mechanisms, steady state and non-steady state diffusion, factors affecting diffusion.

Deformation: Slip, twinning, critical resolved shear stress, effect of cold working and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth.

UNIT – II

Fracture: Types of fracture- ductile and brittle, ductile to brittle transition temperature (DBTT), Fatigue-Endurance limit, S-N Curve, factors affecting fatigue.

Creep: Mechanism of creep, creep curve, basic consideration in the selection of material for high temperature service.

Equilibrium diagram: solids solutions and alloys, Gibbs phase rule, unary and binary eutectic phase diagram, lever rule, Iron- Iron carbide Phase diagram, TTT-diagram, Effect of alloying elements on TTT diagram.

UNIT–III

Heat Treatment: Principles and purpose of heat treatment of plain carbon steels, annealing, normalizing, hardening, tempering, quenching, austempering, martempering, case hardening processes – carburizing, nitriding, cyaniding, induction and flame hardening, Hardenability: determination of hardenability, Jominy end quench test.

Materials: Types of Plain carbon steels, effect of alloying elements on steel, Cast iron-white, grey, malleable and nodular cast iron, properties and application of cast iron, properties and uses of high speed steel, stainless steel, spring steel, Non-ferrous materials.

UNIT– IV

Corrosion: Types of corrosion, mechanism of corrosion, preventions against corrosion.

Introduction to composite materials- Classification, Properties and applications of composite materials.
Surface Coatings: Introduction to metallic coating and coating methods.

Text Books (s):
1. W. D. Callister, David G. Rethwisch, "Materials Science and Engineering: An Introduction", Wiley & Sons; 9thed. (2013).
2. K. I. Parashivamurthy, "Material Science and Metallurgy", Pearson.
3. Sidney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw-Hill, New Delhi; (1997).

Reference Books:
1. L. Krishna Reddi, "Principles of Engineering Metallurgy", New Age Publication, New Delhi; (2001)
2. Buduisky et. al., "Engineering Materials & Properties", Prentice Hall India, New Delhi; (2004)
3. Peter Haasten, "Physical Metallurgy", Cambridge Univ. Press; (1996)
4. Raymond A. Higgin., "Engineering Metallurgy Part 1", Prentice Hall India, New Delhi; (1998)

Paper Code(s): MEC-210	L	P	C
Paper: Thermal Engineering – II	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the working of steam nozzle at design condition and off design condition. To differentiate clearly between impulse and impulse-reaction turbine.
2.	To understand the working of reciprocating compressor & refrigeration cycle.
3.	To understand the combustion in I.C engine and appreciate the concept of knocking.
4.	To be able to compute performance parameters of an I.C engine and to determine components of heat balance of given i.C engine.

Course Outcomes (CO)

CO 1	To determine the mass flow rate through steam nozzle and to be able to determine blade efficiency and stage efficiency of steam turbine blading.
CO 2	To determine work requirement of a reciprocating compressor and to analyze refrigeration system based on vapour compression refrigeration system.
CO 3	Explain the combustion in I.C engine and enumerate the factors responsible for knocking.
CO 4	Evaluate performance parameter of I.C engine and draw heat balance sheet of specified engine.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	2	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	3	-	-	2	-	-	-	-	2

UNIT-I

Steam Nozzle: Types of nozzles, flow of steam through nozzles, condition for maximum discharge through nozzle, nozzle efficiency, effect of friction and off design condition of convergent nozzle and convergent-divergent nozzle.

Steam Turbine: Working principle and types of steam turbines, velocity diagrams for impulse and reaction turbines, compounding of impulse turbines, optimum velocity ratio and maximum efficiency, comparison of impulse and reaction turbines, reheat factor.

UNIT-II

Air Compressors: Steady flow analysis, isothermal, adiabatic and polytropic compression, single- and multi-stage compression, ideal intermediate pressure, compressor clearance, volumetric and isothermal efficiency, minimum work requirement of a compressor.

Refrigeration Cycle: Vapour compression refrigeration cycle, description, analysis, refrigerating effect, power required, unit of refrigeration, COP, Refrigerants and its desirable properties. Vapor absorption refrigeration system.

UNIT-III

Internal Combustion Engine: Combustion in S.I. engine, Combustion in C.I. engine and its stages, Knocking in S.I. and C.I. engine and its detrimental effect, Factors affecting knocking in S.I. and C.I. engine.

UNIT – IV

I.C. Engine performance: Measurement of performance parameters of an engine, different methods to determine Indicated power and friction power of an engine, components of heat balance sheet of a given Engine, Ignition system, Fuel injection system, Lubrication system.

Textbook(s):

1. S. Domkundwar, Thermal Engineering, Dhanpat Rai & Co (p) Ltd.
2. P.K Nag, Applied Thermodynamics, Tata McGraw Hill (p) Limited.
3. Mathur & Sharma, Internal Combustion Engine, Dhanpat Rai Publication.

References:

1. Onkar Singh, Applied Thermodynamics, New Age International (p) Limited.
2. Cohen & Rogers, Gas Turbines, Pearson Prentice Hall, ISBN- 9780582236325.
3. R. K. Rajput, “Engineering Thermodynamics”, Lakshmi Publications.
4. V.Ganesan, “Internal Combustion Engine “, Tata McGraw Hill Publishing Co., New Delhi.
5. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics”, Pearson.

Paper Code(s): MEC-212	L	P	C
Paper: Machine Design – I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand ab-initio design concepts under various constraints, stress concentration and dynamic loading. Also analyse the design of static joints and pipes.
2.	To conceptualise joints for power transmission in rotating parts, suspension parts and in leverage.
3.	To analyse bolted & screwed fastenings and structural plates joining for complex engineering applications under myriad of loads.
4.	To thoroughly understand the design procedure for speed variation effects in toothed elements and power screws.

Course Outcomes (CO)

CO 1	Grasp the systematic design procedure & design principles considering constraints of various methods of manufacture and effect of static & dynamic forces on joints for rods.
CO 2	Synthesis of keyed-coupled shafts and stress analysis of flexible elements & levers.
CO 3	Design analysis of fastening threads and various temporary & permanent joints for plates.
CO 4	Analyse the effect of changing speeds on designed toothed elements and efficient power transmitting devices.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	2	1	1	2	3
CO 2	3	3	3	3	3	2	2	2	1	1	2	3
CO 3	3	3	3	3	3	2	2	2	1	1	2	3
CO 4	3	3	3	3	3	2	2	2	1	1	2	3

UNIT-I

Introduction: Systematic Design Process (SDP), Basic principles for mechanical design, Use of standards. Manufacturing consideration in design of casting & machining parts.
Dynamic and fluctuating stresses, fatigue failure and endurance limit, design under combined direct & varying stresses. Stress concentration, causes and remedies in design.
Factor of safety and it's affecting factors, Tolerances and fits as per BIS, Materials selection, Designation of steels.
Detailed design procedure of Spigot & Socket Cotter joint, Knuckle joint, Pipe joint. Numerical Design Problems.

UNIT-II

Shafts, keys and couplings: Transmission Shafts, materials, design of shafts on strength & rigidity basis and under combined torsional and bending loads as per ASME code. Keys, types and applications. Design of rigid and pin bushed flexible couplings.

Levers, types, Design of Bell crank lever.
Springs and their applications, design of close coiled helical springs. Numerical Design Problems.

UNIT-III

Riveted & Welded Joints: Types of riveted joints, Failure modes, strength equations, joint efficiency, Riveted joint for boiler shells, Riveted joints under direct and eccentric loads. Welded joints, strength of parallel, transverse & combined filled welded joints, axially loaded unsymmetrical welded joint, eccentrically loaded welded joints, welded joints subjected to bending moment and torsional moment.
Threaded Joints: Types of screwed fastenings, Initial tightening loads in bolts, Torque requirement, Uniform strength bolt, Direct & eccentrically loaded bolted joints. Numerical Design Problems.

UNIT - IV

Power Screws: Types of threads of power screws - Square, trapezoidal & Acme threads, Torque requirement, efficiency, irreversibility & self-locking, Complete analysis of design of screw jack.
Spur Gear: Classification of Gears, spur gear terminology, Gear tooth failure, Lewis equation for beam strength of tooth, dynamic and wear loads. Numerical Design Problems.

Textbook(s):
1. V.B. Bhandari, “Design of Machine elements”, Tata McGraw Hill Education Private Ltd. Third Edition (2012)
2. Maleeve Hartman and O.P. Grover, “Machine Design”, CBS Publishers& Distributors Pvt. Ltd. Sixth Edition (2015)

References:
1. K. Mahadevan, “Design Data Book”, CBS Publishers & Distributors.
2. J.E. Shigley & C.R. Mischke, "Mechanical Engineering Design”, Tata McGraw Hill Co. Inc.
3. P.C. Sharma and D.K Aggarwal., “Machine Design”, S.K. Kataria & Sons.
4. R.C. Juvinal andK.M. Marshek, “Fundamentals of Machine component Design”, Wiley India .
5. R.I. Norton, “Machine Design” Pearson.

Paper Code(s): CEC-206	L	P	C
Paper: Soil Mechanics	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the methods of classifying the soils
2.	To analyze the flow of water through soils and to estimate the stress distribution in the soil mass
3.	To estimate the compaction characteristics, compressibility characteristics, settlements
4.	To assess the shear strength of the soils.

Course Outcomes (CO)

CO 1	Classify the soil and determine its Index properties.
CO 2	Evaluate permeability and seepage properties of soil, determine the vertical stress under different loading conditions, phenomenon of soil liquefaction
CO 3	Interpret the compaction and consolidation characteristics & effective stress concept of soil.
CO 4	Determine the shear stress under different loading conditions.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	2	-	-	-	-	-	-	-	-	-	-
CO 4	-	2	-	-	-	-	-	-	-	-	-	-

UNIT-I

Soil Origin and classification: Preview of Geotechnical field problems in Civil Engineering, Soil formation, transport and deposit, Soil composition, Basic definitions, Weight volume relationships, Clay minerals, Soil structure, Index properties, sensitivity and thixotropy, Particle size analysis, Unified and Indian standard soil classification system.

UNIT-II

Soil Hydraulics: Stress conditions in soil-total, effective and neutral stresses and relationships. Permeability - Darcy's Law, hydraulic conductivity, equivalent hydraulic conductivity in stratified soil. Seepage, flow nets, seepage calculation from a flow net, flow nets in anisotropic soils, seepage through earth dam, capillarity, critical hydraulic gradient and quick sand condition, uplift pressure, piping.
Stress Distribution in soil: Elastic constants of soils and their determination, Boussinesq equation for vertical stress, The Westergaard equation, Stress distribution under loaded areas, Concept of pressure bulb, contact pressure.

UNIT-III

Soil compaction, water content: dry unit weight relationships. Factors controlling compaction. Field compaction equipment; field compaction control; Proctor needle method.
Consolidation: Primary and secondary consolidation, Terzaghi's one dimensional theory of consolidation, Consolidation test, Normal and Over Consolidated soils, Over Consolidation Ratio, determination of coefficient of consolidation.

UNIT – IV

Shear Strength: Mohr-Coulomb failure criterion, shear strength parameters and determination; direct and tri-axial shear test; unconfined compression test; pore pressure, Skempton's pore water pressure coefficients and Soil liquefaction.

Textbook(s):
1. Gopal Ranjan and A. S. R. Rao, “Basic and Applied Soil Mechanics”, New Age International Publishers; 4th Edition (2022).
2. Dr B.C. Punmia, Er A.K. JAIN, & Dr A.K. Jain, “Soil Mechanics and Foundations”, Laxmi Publications; 17th Edition (2017).

Reference Books:
1. Dr K.R. Arora, “Soil Mechanics and Foundation Engineering”, Standard Publisher Dist., (2020)
2. Venkataramaiah, “Geotechnical Engineering” New Age International Publishers.
3. V.N.S. Murthy, “Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering”, (2016).
4. P. Purushothama Raj, “Soil Mechanics and Foundation Engineering”, Pearson Education India, (2013).
5. Geotechnical Engineering [Principles and Practices] P.Donald,Coduto,PHI Publications
6. Soil mechanics in engineering practice by Karl Terzaghi, Ralph Brazelton Peck, Gholamreza Mesri,Wiley.
7. Soil mechanics by Lambe and Whitman Wiley edition
8. Geotechnical Engg, Gulati and Dutta, McGrawHill Education (I) Pvt. Ltd1. E. Ward Cheney & David R. Kincaid

Paper Code(s): CEC-208	L	P	C
Paper: Hydraulics and Hydrology	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Define different types of flow and their conditions with limitations.
2.	Develop an expression for types of flows and their characteristics. To know about the hydrological cycle process.
3.	To Assess the Storage capacity of the reservoir and the process of mitigating floods.
4.	To determine flow characteristics.

Course Outcomes (CO)

CO 1	Able to understand and explain the flows in hydraulic structures.
CO 2	Able to determine various components of the hydrologic cycle affecting the movement of water in the earth and various Stream flow measurements technique
CO 3	Able to evaluate the hydrologic parameters
CO 4	Able to determine and analyze groundwater hydraulics.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	2	-	-	-	-	-	-	-	-	-	-
CO 4	-	2	-	-	-	-	-	-	-	-	-	-

UNIT-I

Channel Hydraulics: - Energy and Momentum Principles: Critical depth, the concept of specific energy and specific force, application of specific energy principle for the interpretation of open channel phenomenon, flow through vertical and horizontal contractions. Equation of gradually varied flow and its limitations, flow classification and surface profiles, integration of varied flow equation by analytical, graphical, and numerical methods, flow in a curved channel.

UNIT-II

Hydraulic Jump, Surges, Water Waves: Classical hydraulic Jump, evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, equation of motion for unsteady flow, open channel surge, celerity of the gravity wave, deep and shallow water waves.
Introduction, Hydrologic cycle, Climate and water availability, Water balances, Precipitation: Forms, Classification, Variability, Measurement, Data Analysis, Evaporation, and its measurement, Evapotranspiration and its measurement, Penman-Monteith method. Infiltration: Factors affection infiltration, Horton's equation, and Infiltration indices.

UNIT-III

Runoff: drainage basin characteristics, Hydrograph concepts assumptions and limitations of unit hydrograph, Derivation of unit hydrograph S hydrograph, Flow duration curve. Site selection, Zones of storage, Safe yield, Reservoir capacity, Reservoir sedimentation, and control. Causes of flooding and flood control measures. Channel improvement, Flood damage analysis. Design flood, Flood estimation, Frequency analysis, Flood routing through reservoirs and open channels, and Storm drainage design.

UNIT – IV

Occurrence and movement of groundwater, Darcy's law, governing groundwater flow equations, Factors governing groundwater flow, Types of aquifers, porosity, specific yield, specific retention, storage coefficient, permeability, hydraulic conductivity, hydraulic transmissibility, Conjunctive use and its necessity.

Textbook(s):
1. Fluid Mechanics: Including Hydraulic Machines by A.K. Jain.
2.Subramanya, K., Engineering Hydrology, Tata McGraw Hill, New Delhi.
3. Raghunath, H.M., Groundwater, 1987, Wiley Eastern Ltd., New Delhi.
4. Fluid Mechanics by RK Bansal.

References:
1. Modi, P.N., Irrigation Water Resources, and Water Power Engineering, Standard Book House, New Delhi.
2. Todd, D.K., Groundwater Hydrology, 1993 John Wiley & Sons.
3. Raghunath, H.M., Hydrology – Principles, Analysis and Design, 1986, Wiley
4. Dr. P.Jaya Rami Reddy, A Textbook of Hydrology, University Science Press.
5.Garg S.K., Hydrology and Water Resources Engineering

Paper Code(s): CEC-210	L	P	C
Paper: Environmental Engineering - I	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To make the students conversant with sources and its demand of water
2.	To understand the basic characteristics of water and its determination
3.	To provide adequate knowledge about the water treatment processes and its design
4.	To have adequate knowledge on operation and maintenance of water supply

Course Outcomes (CO)

CO 1	Explain the unit process and operations for waste water treatment
CO 2	Construct the sewerage and plumbing system
CO 3	Examine the advanced wastewater treatment methods
CO 4	Design the suspended and attached growth waste water treatment systems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	-	-	-	-	1	-	-	-	-	-
CO 2	2	2	2	-	-	-	2	-	-	-	-	-
CO 3	-	-	1	-	-	-	3	-	-	-	-	-
CO 4	3	2	3	-	-	-	-	-	-	-	-	-

UNIT-I

Sewerage systems and their components: Introduction to sewerage system, Estimation of sewerage and drainage discharge, Dry weather flow, capacity of sewers, self-cleansing and non-scouring velocities, calculations of sizes and grades, forms and cross sections of sewers, hydraulic characteristics of circular sewer sections, use of tables and monograms, egg shaped sewers, systems of drainage, separate, combined and partially combined systems.
Quality and characteristics of sewage: physical, chemical and biological characteristics of sewage, Aerobic and anaerobic decomposition of sewage, nitrogen, sulphur and carbon cycles, collection of sewage sample, bacteriological and virological testing.
Sewage disposal: Disposal of treated / untreated / partially treated effluents in natural water bodies, Standard for effluent disposal on land, Disposal by land treatment / sewage farming methods, sewage sickness and its preventive measures, Treatment standards for sewage effluents, Bangalore and Indore methods of disposal.

UNIT-II

Engineered systems for waste water treatment: Types of treatment units in preliminary, primary and secondary treatment, their functions and efficiencies, analysis and design of screening, grit chambers, detritus tanks, skimming tanks, design of septic tanks and Imhoff tanks.
Ponds and lagoons: Principle, operations, construction, design and detailing of Oxidation ponds, Aerated

lagoons, Facultative ponds, Oxidation ditches, anaerobic lagoons.
Attached culture systems: System microbiology, Contact beds, Principle, operations, Construction and design details of Trickling filters, Bio towers, Rotating biological contractors (RBC).

UNIT-III

Design of Suspended culture systems : Activated sludge, concept of completely mixed and Plug flow reactors, process variation and design considerations, Aeration of activated sludge, Air diffusers and mechanical aerators, activated sludge clarifiers, Secondary clarifier design based on limiting flux rate.
Advanced waste water treatment: Nutrient removal, Nitrification and Denitrification, Air stripping for ammonia removal, phosphorus removal, dissolved solids removal, Waste water reuse.
Sludge thickening and sludge digestion: Sludge characteristics, sludge volume and solids relationships, Aerobic and anaerobic digestion, Factors affecting sludge digestion and their control, disposal of digested sludge.

UNIT - IV

Sewage collection from houses and buildings: General principles for design of sanitary plumbing system, Functions and types of traps, types of plumbing systems, one pipe / two pipe, single stack / partially ventilated single stack system.
Construction and maintenance of sewers: Forces acting on sewer pipes, materials used in construction, laying and testing of sewer pipes, sewer appurtenances such as manholes, street inlets, gullies, catch basins, grease and oil traps, storm water overflows, inverted siphons, flushing and ventilation of sewers, Pumps for lifting sewage.

Text Books:
1. S.K. Garg, “Water Supply Engineering”, Khanna Publishers.
2. Davis and Cornwell, “Introduction to Environmental Engineering”, McGraw Hill
3. Peavy, Rowe and Tchobanoglous, “Environmental Engineering”, McGraw Hill

References:
1. Henry and Heinke, “Environmental Science and Engineering”, Prentice Hall India
2. Venugopala Rao, “Principles of Environmental Science and Engineering”, Prentice Hall India
3. Gilbert M. Masters, “Introduction to Environmental Engineering” Prentice Hall India.
4. Kiely, Gerardd “Environmental Engineering” Tata McGraw Hill
5. Hammer, Hammer “Water and Wastewater Technology” PHI Learning Pvt. Ltd
6. Qasim, Motley, Zhu “Water works engineering” PHI Learning Pvt. Ltd.
7. C.D.Gupta, V.K.Gupta “Water Supply Handbook” Jain Brothers

Paper Code(s): CEC-212	L	P	C
Paper: Transportation Engineering	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the principles and practices of transportation engineering
2.	To have the capability to identify and solve transportation problems within the context of data availability and limitations of analysis tools
3.	To understand the basics of highway planning and design, and workout problems in design of road geometrics
4.	To deal with the characteristics of aircrafts related to airport design; runway and taxiway design,

Course Outcomes (CO)

CO 1	Conduct various engineering studies and survey for the design of transportation facilities.
CO 2	Develop the skills of highway, railway & Airport planning.
CO 3	Geometric design of roadway, railway & airport.
CO 4	Recommend suitable transportation systems like metros, railways, and airways to provide a substantiated conclusion.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	2	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	-	-	3	-	-	2	-	1	-	-	-	-
CO 4	-	1	-	-	-	-	-	-	-	-	-	-

UNIT-I

Highways development Planning: Introduction, Different modes of transport, Development of Transport System, Phased development of Roads in India. Highway Surveys & Alignment, Design, Drawings, Estimates & Project Report.

UNIT-II

Geometric Design of Highways: Introduction, Highways Classification, Right of way, Land width, width of formation, width of pavement, Sight Distances, camber, horizontal and vertical Road Curves, Transition Curves.

UNIT-III

Developments in Indian Railways , Different Modes of Transport , Organization of Indian Railways , Indian Railway Finances and their Control, Gauges on World Railways, Different Gauges on Indian Railways, Choice of Gauge, Problems Caused by Change of Gauge, Necessity for Geometric Design, Details of Geometric Design of Track, Gradients, Grade Compensation on Curves, Circular Curves, Superelevation, Safe Speed on Curves, Transition Curve, Compound Curve, Reverse Curve, Extra Clearance on Curves, Widening of Gauge on Curves, Vertical Curves, Realignment of Curves, Cutting Rails on Curves, Check Rails on Curves.

UNIT – IV

Airport Engineering: Introduction to Air Transportation – Aircraft Characteristics – Factors Affecting Selection of site for Airport – Aprons – Taxiway – Hanger – Geometric design – Computation of Runway Length, Correction for Runway Length, Orientation of Runway, Wind Rose Diagram

Text Books

1. Highway Engineering by Khanna and Justo, Nem Chand & Brothers, Roorkee
2. Subhash C. Saxena (2008) Airport Engineering, Planning and Design, CBS Publishers and Distributors
3. Saxena SC and Arora S C (2010) A Text Book of Railway Engineering, Dhanpat Rai Publications

Reference Books

1. Highway Engineering by L.R. Kadiyali
2. Transportation Engineering by G.V. Rao, Tata McGraw Hill Publisher, New Delhi
3. Principles of Pavement Design by E.J. Yodder
4. Traffic Engineering by Matson,Smith&Hurd

Paper Code(s): MAC-210	L	P	C
Paper: Database Management Systems	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the basic concept of Database management system and Client Server Architecture
2.	To understand the concepts of the ER model and Relation model
3.	To introduce basics of relational database design, PL SQL and NO SQL
4.	To introduce concept of transaction, security and learn basics of DBMS for CAD/CAM

Course Outcomes (CO) :

CO 1	To understand basics of database management system and SQL
CO 2	To learn the concepts of the ER model and Relation model
CO 3	To understand benefits of relational database design, PL SQL and NO SQL
CO 4	To understand properties of transaction, security and relationship of CAD/CAM with DBMS

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	1	1	3	-	-	-	2	2	2	3
CO 2	3	3	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	1	1	2	-	-	-	2	2	2	3

UNIT – I

Basic concepts: Advantages of a DBMS over file processing system, Data Abstraction, Database Languages, Data Independence. , Components of a DBMS and overall structure of a DBMS, Three views of Data (External View, Conceptual View, Internal View), Three level architecture of DBMS, Data Independence, Client Server Architecture

SQL: Data definition language, Data manipulation language, SQL, Object naming conventions, Object naming guidelines, Data types, Tables (Creating , Inserting, Updating and deleting tables and using constraints), Views, Indexes, SQL Command :- DESCRIBE, SELECT, WHERE CLAUSE, DISTINCT CLAUSE, ORDER BY,HAVING, LOGICAL OPERATIONS, SQL OPERATORS, JOIN Aggregate functions, String functions and date time functions, Null values

UNIT - II

ER Model : Entity sets and relationship sets- Attributes - Keys in entity and relationship sets : (a) Super Key (b) Candidate Key (c) Primary Key (e) Unique Key - Mapping constraints, Participation Constraint, E-R diagram, Notations. Strong Entity Set and Weak Entity Set

Relation Model: Advantages, Disadvantages, Codd's 12 rules, Definition of Relations, Schema, Sub schema. Relational Model Constraints (Domain, Tuple Uniqueness, Key Constraints, Integrity Constraints, Entity constraints). Relations algebra (Basic operation: Union intersection difference and Cartesian product), Additional Relational Algebraic Operations (Projection, Selection rows, Division, rename and join) , Converting ER Model to Relational Model

UNIT – III

Relational Database Design: Purpose of Normalization, Data redundancy and updating anomalies, Functional Dependencies and Decomposition, Process of Normalization using 1NF, 2NF, 3NF, multivalued dependencies and BCNF, Forth Normal Form, Fifth Normal Form

Database Programming: User defined function, Control of flow statement, Procedures/Stored procedures, triggers, granting and revoking.

NO-SQL: Introduction, Usages and Application.

UNIT - IV

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures.

Security: Authorization and View- Security constraints - Integrity Constraints- Encryption

CAD/CAM and database management: The need for CAD/CAM Database management system, CAD/CAM applications using DBMS

Textbooks:

1. Date, C. J., “An introduction to database systems”, 8th Edition, Pearson Education, 2008.
2. R. Elmsari and S. B. Navathe, “Fundamentals of database systems”, Pearson Education, 7th Edition, 2018
3. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications
4. V. M. Grippa and S. Kumichev, “Learning MySQL”, O’Reilly, 2021.

References:

1. A. Silberschatz, H. F. Korth and S. Sudershan, “Database System Concept”, McGraw Hill, 6th Edition,2013.
2. P. Rob & C. Coronel, “Database Systems: Design Implementation & Management”, Thomson Learning, 6th Edition, 2004
3. Joel Murach, “Murach's Mysql”, 3rd Edition-Mike Murach and Associates, Incorporated, 2019.
4. Desai, B., “An introduction to database concepts”, Galgotia publications, 2010
5. H. Garcia-Molina, J. D. Ullman, J. Widom, “Database System: The Complete Book”, PH.
6. Kenndy E Lee. CAD: Drawing design, Data Management, Watson-Guptill, 1986
7. Oracle and MySQL manuals.

Paper Code(s): MAC-212	L	P	C
Paper: Thermodynamics and Applications	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the concepts of phase change and to be able to determine entropy change for a process.
2.	To understand the working of Vapor power & refrigeration cycle.
3.	To understand the working of Internal combustion engine and to be able to compare the performance of Air standard cycle under stated condition.
4.	To be able to compute performance parameters of an I.C engine and to determine components of heat balance of given I.C. engine.

Course Outcomes (CO)

CO 1	Evaluate the properties of a pure substance and determine entropy changes for different types of processes
CO 2	Analyze the performance of vapor power & refrigeration cycle.
CO 3	Examine various gas power cycles and compare their performance under specified conditions
CO 4	Evaluate performance parameter of I.C engine and draw heat balance sheet of specified engine.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	2	-	-	-	-	2
CO 3	3	3	3	3	-	-	2	-	-	-	-	2
CO 4	3	3	3	3	-	-	2	-	-	-	-	2

UNIT-I

Basic definitions and Laws of Thermodynamics: Revision of concept of heat and work transfer for different processes, First law analysis of open system, Steady flow energy equation and its application for nozzle, diffuser, heat exchangers, Turbine and Compressors and throttling device, Second law of thermodynamics and its significance, Concept of entropy, entropy property of system, entropy change of various reversible processes, Entropy generation and its significance.

Steam: Generation of steam at constant pressure, difference between saturated liquid, wet steam, dry saturated steam, superheated steam and compressed liquid and their properties determination by using Pressure base steam table and temperature base steam table, Use of Moiller chart to determine properties of steam at a state and for a process.

UNIT-II

Vapour Power Cycle: Carnot Cycle and why it is impracticable, Basic Rankine Cycle and its thermal analysis, Concept of mean temperature of heat addition, Comparison of Carnot cycle and Rankine cycle, Performance

parameter of Rankine cycle.
Refrigeration Cycle: Vapour compression refrigeration cycle; description, analysis, refrigerating effect, power required, unit of refrigeration, COP, Refrigerants and its desirable properties, Vapor absorption refrigeration system.

UNIT-III

Gas power cycle: Air Standard Power Cycle, Otto, diesel and dual cycles, Representation on P-V and T-S diagram, Thermal efficiency and Mean effective pressure of Otto, Diesel and Dual cycle, Comparison of air standard cycle based on same maximum pressure, same compression ratio.
Internal Combustion Engine: Combustion in S.I. engine, Combustion in C.I. engine and its stages, Knocking in S.I. and C.I. engine and its detrimental effect, Factors affecting knocking in S.I. and C.I. engine.

UNIT – IV

I.C. Engine performance: Two stroke and four stroke cycle, Measurement of performance parameters of engine i.e., B.P, I.P., F.P, SFC, thermal efficiency, mechanical efficiency and volumetric efficiency of engine, Different methods to determine Indicated power of an engine, components of heat balance sheet of a given engine.

Textbook(s):

1. P K Nag, "Basic and Applied Thermodynamics" 5th edition McGraw Hill.
2. Y. A. Cengel & M. A Boles "Thermodynamics- An Engineering Approach", 6th edition Tata McGraw Hill.
3. M.L. Mathur and R.P. Sharma Internal Combustion Engine, Dhanpat Rai Publication

References:

1. M.J. Moran & H.N. Shapiro "Fundamentals of Thermal Engineering" John Wiley & son.
2. S L Somasundaram "Engineering Thermodynamics", New Age International Publishers.
3. R. K. Rajput, "Engineering Thermodynamics", Lakshmi Publications.
4. Gordon Rosers, & Yon Mahew; Engineering Thermodynamics", Pearson

Paper Code(s): BS-252	L	P	C
Paper: Probability, Statistics and Linear Programming Lab	**-**	**2**	**1**

Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term end Theory Examinations: 60 marks
Instructions: 1. The course objectives and course outcomes are identical to that of (Probability, Statistics and Linear Programming) as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in MATLAB or in equivalent software.

1. Installation of Scilab and demonstration of simple programming concepts like marix multiplication (scalar and vector), loop, conditional statements and plotting.

2. Program for demonstration of theoretical probability limits.

3. Program to plot normal distributions and exponential distributions for various parametric values.

4. Fitting of binomial distributions for given n and p.

5. Fitting of binomial distributions after computing mean and variance.

6. Fitting of Poisson distributions for given value of lambda.

7. Fitting of Poisson distributions after computing mean.

8. Fitting of normal distribution when parameters are given.

9. Fitting of linear regression line through given data set and testing of goodness of fit using mean error.

10. Fitting of Multiple Linear Regression (MLR) curve through given data set and testing of goodness of fit using mean error.

11. Solve a LPP of three variable using Simplex Method.

12. Solve a Transportation problem of three variables.

13. Solve an Assignment problem of three variables.

Paper Code(s): CIC-256	L	P	C
Paper: Database Management System Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Database Management System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Experiments based on DDL commands – CREATE, ALTER, DROP and TRUNCATE.
2. Apply the integrity constraints like Primary Key, Foreign key, Check, NOT NULL, etc. to the tables.
3. Experiments based on basic DML commands – SELECT, INSERT, UPDATE and DELETE.
4. Write the queries for implementing Built-in functions, GROUP BY, HAVING and ORDER BY.
5. Write the queries to implement the joins.
6. Write the queries to implement the subqueries.
7. Write the queries to implement the set operations.
8. Write the queries to create the views and queries based on views.
9. Demonstrate the concept of Control Structures.
10. Demonstrate the concept of Exception Handling.
11. Demonstrate the concept of Functions and Procedures.
12. Demonstrate the concept of Triggers.

Paper Code(s): CIC-258	L	P	C
Paper: Programming in Java Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Programming in Java) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a java program to implement stack and queue concept.
2. Write a java program to produce the tokens from given long string.
3. Write a java package to show dynamic polymorphism and interfaces.
4. Write a java program to show multithreaded producer and consumer application.
5. Create a customized exception and also make use of all the 5 exception keywords.
6. Convert the content of a given file into the uppercase content of the same file.
7. Write a program in java to sort the content of a given text file.
8. Develop an analog clock using applet.
9. Develop a scientific calculator using swings.
10. Create an editor like MS-word using swings.
11. Create a servlet that uses Cookies to store the number of times a user has visited your servlet.
12. Create a simple java bean having bound and constrained properties.

Paper Code(s): ECC-256 / ECC-363	L	P	C
Paper: Microprocessors and Microcontrollers Lab	**-**	**2**	**1**

Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term end Theory Examinations: 60 marks
Instructions: 1. The course objectives and course outcomes are identical to that of (Microprocessors and Microcontrollers) as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to add and subtract two 16-bit numbers with/ without carry using 8086.
2. Write a program to multiply two 8 bit numbers by repetitive addition method using 8086.
3. Write a Program to generate Fibonacci series.
4. Write a Program to generate Factorial of a number.
5. Write a Program to read 16-bit Data from a port and display the same in another port.
6. Write a Program to generate a square wave using 8254.
7. Write a Program to generate a square wave of 10 kHz using Timer 1 in mode 1(using 8051).
8. Write a Program to transfer data from external ROM to internal (using 8051).
9. Design a Minor project using 8086 Microprocessor (Ex: Traffic light controller/temperature controller etc)
10. Design a Minor project using 8051 Micro controller

Paper Code(s): ECC-258	**L**	**P**	**C**
Paper: Digital Communications Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Digital Communications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To Study Sampling Theorem.
2. To Study of Pulse Code Modulation and Probability of error.
3. To calculate S/N ratio and Probability of error of Differential Pulse Code Modulation.
4. To calculate S/N ratio and Probability of error of Delta Modulation.
5. To calculate S/N ratio and Probability of error of Adaptive Delta Modulation.
6. To calculate S/N ratio and Probability of error of Amplitude Shift Keying (ASK).
7. To calculate S/N ratio and Probability of error of Phase Shift Keying (PSK).
8. To calculate S/N ratio and Probability of error of frequency Shift Keying (FSK).
9. To calculate S/N ratio and Probability of error Differential Phase Shift Keying Modulation (DPSK).
10. To calculate S/N ratio and Probability of error of Quadrature Phase Shift Keying Modulation (QPSK).
11. To calculate S/N ratio and Probability of error of QAM
12. Faculty can opt for practical of Digital Communication to be performed on Kit.

Paper Code(s): ECC-260	L	P	C
Paper: Analog Electronics – II Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Analog Electronics - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study the op-amp (IC 741) as inverting and non-inverting amplifier and calculate its gain.
2. Observe and plot the output Wave shape of Op-Amp R-C differentiating circuits, R-C integrating circuits for square wave input
3. To study the op-amp (IC 741) as adder, subtractor and voltage follower, calculate its output voltage..
4. Construct biased and unbiased series and shunt clipping circuits & combinational clipper circuit for positive and negative peak clipping of a sine wave.
5. To study RC phase shift/Wien Bridge oscillator measurement of frequency and amplitude of oscillations using Op-Amp.
6. To study the waveform of square wave generator using 741 Op-Amp IC.
7. To study the waveform of Schmitt Trigger circuit & Precision Rectifier using 741 OP-AMP IC.
8. To make and test the operations of Monostable Multivibrator circuits using 555 timer.
9. To make and test the operations of Astable Multivibrator circuits using 555 timer.
10. To study the Sallen Key Voltage controlled voltage source active filters.

Paper Code(s): EEC-262	L	P	C
Paper: Network Analysis and Synthesis Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Network Analysis and Synthesis) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Study the transient response of series RLC circuit for different types of waveforms on CRO and verify using MATLAB
4. Study the time response of a simulated linear system and verify the unit step and square wave response of first order and second order, type 0,1 system
5. Using MATLAB determine current in various resistors connected in network using mesh current and node voltage analysis.
6. To determine Z and Y parameters of the given two port network.
7. To determine ABCD parameters of the given two port network.
8. To verify Reciprocity Theorem for the given two port network.
9. To determine Hybrid parameters of the given two port network.
10. To design Cascade Connection and determine ABCD parameters of the given two port network.
11. To design Series-Series Connection and determine Z parameters of the given two port network.
12. To design Parallel-Parallel Connection and determine Y parameters of the given two port network.
13. To design Series-Parallel Connection and determine h parameters of the given two port network
14. Study the frequency response of different filter circuits.

Paper Code(s): EEC-256	L	P	C
Paper: Electrical Machines – II Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electrical Machines - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To conduct no-load and blocked rotor test on three phase squirrel cage Induction motor and draw the equivalent circuit.
2. To conduct the load test on three phase squirrel cage Induction motor
   (a) Compute torque, output power, efficiency, input power factor and slip for various load settings.
   (b) To plot the following curves on the same graph sheet from the data obtained in part
      (1) Efficiency vs. output power.
      (2) Torque vs. output power.
      (3) Line current vs. output power.
      (4) Power factor vs. output power.
      (5) Slip vs. output power.
   (c) Also plot Torque-slip characteristic.
3. To conduct the load test on three phase slip ring Induction motor
   (a) Compute torque, output power, efficiency, input power factor and slip for various load settings.
   (b) To plot the following curves on the same graph sheet from the data obtained in part
      (1) Efficiency vs. output power.
      (2) Torque vs. output power.
      (3) Line current vs. output power.
      (4) Power factor vs. output power.
      (5) Slip vs. output power.
   (c) Also plot Torque-slip characteristic.
4. To study the different methods available in laboratory for of starting three-phase Induction motor and compare them.
5. To find the effect of the variation of supply voltage on the performance of three-phase Induction motor at 120%, 100%, 80%, 60%, and 50% of rated voltage and plot the variation of power factor, speed, current and input power for different voltages.
6. a) Perform no load and short circuit test on a three-phase synchronous generator.
   b) Measure the resistance of the stator windings
   c) Find the voltage regulation at full load at
      (i) Unity power factor
      (ii) 0.85 power factor leading
      (iii) 0.85 power factor lagging by synchronous impendence method.
7. To synchronize a three-phase synchronous generator with the infinite bus bar. (main supply)
8. To start a synchronous motor and study the effect of variation of field current upon the stator current and power factor, hence draw V and inverted V curves of the motor for ½ load, ¾th load and full load. Also draw the unity power factor curve.
9. To perform slip test on a 3 phase synchronous machine and find direct axix and quadrature axix synchronous reactances (Xd, Xq).
10. To study voltage build up in isolated Induction generator and find its load characteristics using suitable terminal capacitor.
11. To conduct no-load and blocked rotor test on single phase squirrel cage Induction motor and draw the equivalent circuit.

Paper Code(s): EEC-260	L	P	C
Paper: Power Systems – I Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Power Systems - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of constructional features, applications, power rating of LT and HT cables
2. Measurement of Inductance, Capacitance, Resistance and Insulation Resistance of multi-core cables.
3. Study of different types of distribution systems by physical inspection of these systems.
4. Study and calculation of ABCD parameters for a Transmission Line.
5. Study of Ferranti Effect for Transmission Line.
6. Study of different types of insulators with rating. Enumerate the different application of the different types of insulators, with their properties.
7. Calculate the resistance of earth using earth electrodes and Megger.
8. Calculate the dielectric strength of the transformer oil.
9. Enumerate the different applications involved in the power generating station. Write a report on visit of Thermal/Hydro/Nuclear power station.
10. Estimation and Costing of overhead lines/distribution lines of specified voltage level and length.
11. Estimation and Costing of service mains for single face, three face domestic/industrial consumers.
12. Estimation and Costing of pole mounted sub-station /indoor outdoor sub-station.
13. To locate fault in a cable by Murray loop test.

Paper Code(s): ECC-264	L	P	C
Paper: Electronics – II Lab	**-**	**2**	**1**

Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term end Theory Examinations: 60 marks
Instructions: 1. The course objectives and course outcomes are identical to that of (Electronics - II) as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Plotting input and output characteristics and calculation of parameters of a transistor in common emittr configuration.
2. Transistor biasing circuit. Measurement of operating point (Ic and Vce) for a :-
    a) fixed bias circuit
    b) Potential divider biasing circuit.
3. Plot the FET characteristics & MOSFET characteristics.
4. Two Stage R.C. Coupled Amplifier.
    a) To measure the overall gain of two stages at 1 KHz and compare it with gain of Ist stage,
    b) To observe the loading effect of second stage on the first stage.
    c) To plot the frequency response curve of two stage amplifier.
5. To study Emitter follower circuit & measurement of voltage gain and plotting of frequency response Curve.
6. Feedback in Amplifier. Single stage amplifier with and without bypass capacitor,measurement of voltage gain and plotting the frequency response in both cases.
7. To study the opamp (IC 741) as inverting and non-inverting amplifier and calculate its gain.
8. To study the opamp (IC 741) as adder, sub-tractor and voltage follower, calculate its output voltage.
9. Construct biased and unbiased series and shunt clipping circuits & combinational clipper circuit for positive and negative peak clipping of a sine wave.
10. To study RC phase shift/WIEN BRIDGE oscillator
11. To study the waveform of square wave generator using 741 OP-AMP IC.

Paper Code(s): ECC-254	L	P	C
Paper: Digital Electronics Lab	**-**	**2**	**1**

Marking Scheme: 1. Teachers Continuous Evaluation: 40 marks 2. Term end Theory Examinations: 60 marks
Instructions: 1. The course objectives and course outcomes are identical to that of (Digital Electronics) as this is the practical component of the corresponding theory paper. 2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Realize all gates using NAND & NOR gates
2. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
3. Realize a BCD adder
4. Realize a Serial Adder
5. Realize a four bit ALU
6. Realize Master-Save J K Flip-Flop, using NAND/NOR gates
7. Realize Universal Shift Register
8. Realize Self-Starting, Self Correcting Ring Counter
9. Realize Multiplexer and De-Multiplexer
10. Realize Carry Look ahead Adder / Priority Encoder
11. To make and test the operations of Monostable Multivibrator circuits using 555 timer.
12. To make and test the operations of Astable Multivibrator circuits using 555 timer.
13. To be familiar with Digital to Analog converters.
14. To be familiar with Analog to Digital converters.

Paper Code(s): ICC-256	L	P	C
Paper: Sensors and Transducers Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Sensors and Transducers) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of static and dynamic characteristics of sensors.
2. Measurement of displacement using LVDT
3. Measurement of strain using strain gauge transducer.
4. Measurement of displacement using potentiometer.
5. Measurement of temperature using RTD and plot the characteristics of RTD.
6. Measurement of temperature using thermister.
7. Measurement of pressure using Load cell.
8. Measurement of speed using magnetic sensor.
9. Measurement of speed using photoelectric sensors.
10. Measurement of pressure using pressure transducer.
11. Measurement of liquid level using capacitive sensor.

Paper Code(s): EEC-258	L	P	C
Paper: Electrical and Electronics Measurements Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Electrical and Electronics Measurement) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To measure inductance using Maxwell bridge.
2. To measure inductance using Anderson's bridge.
3. To measure capacitance using Schering bridge.
4. To measure low resistance using kelvin double bridge.
5. To measure Time, phase and frequency using CRO.
6. Testing of ratio error and phase error using Current Transformer.
7. Measurement of power line parameters (V, I, W, F, VAR, KWH etc.) using series R, RL & RLC Load.
8. Measurement of power in 3-phase circuit.
9. To study Instrumentation amplifier.
10. To measure unknown voltage using potentiometer.

Paper Code(s): MEC-254	L	P	C
Paper: Manufacturing Science and Technology – II Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Manufacturing Science and Technology - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Generation of different angles of a single point cutting tool on a sample workpiece.
2. Perform various machining operations on lathe machine tool.
3. To evaluate shear angle as a function of the rake angle of the tool.
4. Measurement and analysis of cutting forces in orthogonal turning for different materials at different speeds, feed and depth of cut.
5. Measurement of temperature at tool chip interface.
6. A study of chips formed at different speed, feed, depth of cut, for different materials
7. Flank wear – time characteristics for single point cutting tools for different materials at different speeds, feed and depth of cut.
8. To study the characteristic features of milling machine and to machine the hexagonal head of a workpiece.
9. To study the characteristic features of Shaper and to machine a V-block out of the workpiece provided.
10. To study the characteristic features of a Drilling machine and to drill, ream and tap holes on the given workpiece.
11. To study the characteristics of CNC Lathe and CNC milling machines.
12. To study the characteristic features of Electric Discharge Machining processes.

Paper Code(s): MEC-256	L	P	C
Paper: Thermal Engineering – II Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Thermal Engineering - II) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1.To conduct the performance test on the Diesel engine test rig.

2. To conduct the performance test on the Petrol engine test rig

3. To prepare heat balance sheet of single cylinder four stroke diesel engine.

4. To prepare heat balance sheet of single cylinder four stroke Petrol engine.

5. To determine COP of refrigeration system based on vapor compression Cycle.

6. Study the working of different types of Compressors.

7. Visit to the refrigeration plant.

8. Determine the effect of load on the components of Heat balance of an I.C engine.

9. Determine the composition of exhaust gas by Orsat Apparatus.

10. Study the working of Vapor Absorption Refrigeration System.

Paper Code(s): MEC-258	L	P	C
Paper: Machine Design – I Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Machine Design - I) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To design and draw a Spigot and Socket Cotter Joint for a given load under the allowable stress properties of the material.
2. To design and draw a Knuckle Joint for a given load under the material properties constraints.
3. To design and draw a pipe joint carrying pressured fluid within safe stress capabilities of the givens material.
4. To design and draw a protected type Rigid Flanged Coupling for connecting two power transmitting perfect coaxial shafts.
5. To design and draw a bushed pin type Flexible Coupling (Ajax) for connecting two slightly misaligned shafts.
6. To design a quadruple riveted double strap butt joint for the longitudinal seam and circumferential seam of a boiler shell.
7. To design and find the size of an eccentrically loaded Welded Joint.
8. To design and draw a Screw Jack for lifting a given load.
9. To design a pair of Spur Gear Reducer for transmitting a given power between two shafts.
10. To design a Bell Crank Lever for moving a given load with a given mechanical advantage.
11. To design a closed coiled helical spring for the valve mechanism of an engine.

Note: The drawing/drafting of the designed parts based on the actual calculations must be done on any suitable available drafting software.

Paper Code(s): CEC-254	L	P	C
Paper: Soil Mechanics Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Soil Mechanics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Moisture content determination by oven drying method, pycnometer method, and rapid moisture meter
2. Specific Gravity of soil particles by Pycnometer method and Density Bottle method
3. Particle size distribution of soils [Grain size analysis] by Sieve analysis and Hydrometer analysis.
4. Atterberg’s limits [liquid Limit, Plastic Limit and Shrinkage Limit] tests
5. Field density tests of soils by Core cutter method and sand replacement method
6. Permeability tests of soils by Variable head method and Constant head method
7. Soil compaction test [Density moisture relations]
8. Consolidation test
9. Triaxial compression test
10. Unconfined compression test

Paper Code(s): CEC-256	L	P	C
Paper: Hydraulics Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Hydraulics and Hydrology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To study and compare the losses due to flow in smooth and rough pipes.
2. To draw the performance characteristics of variable speed centrifugal pump and single stage reciprocating pump.
3. To determine operating characteristics of pelton wheel turbine.
4. To determine operating characteristics of Francis turbine.
5. To determine operating characteristics of Kaplan turbine.
6. Reynolds dye experiment for flow characterization.
7. To determine the lift and drag force on different airfoils.
8. Measurement of Rainfall by non –recording rain gauge.
9. Measurement of rainfall by recording rain gauge.
10. To determine mean rainfall of an area by Thiessen mean Polygon method and isohyetal method.
11. To determine the velocity of a running of a stream in a canal by current meter and calculate the approximate discharge of the canal.
12. To design a regime channel by Lacey's theory for a given pattern of crops and area to be irrigated.

Paper Code(s): CEC-258	L	P	C
Paper: Transportation Engineering Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Transportation Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Aggregate crushing strength test.
2. Los Angeles Abrasion test.
3. Aggregate impact test.
4. Flakiness index and elongation index test.
5. Penetration test
6. Ductility test
7. Viscosity test.
8. Softening point test.
9. Flash and fire point test.
10. Determination of bitumen content by centrifuge extractor
11. Determination of marshal stability value.
12. Determination of rebound deflection of pavement by Benkelman beam.

Paper Code(s): MAC-256	L	P	C
Paper: Database Management Systems Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Database Management System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Experiments based on DDL commands – CREATE, ALTER, DROP and TRUNCATE.
2. Apply the integrity constraints like Primary Key, Foreign key, Check, NOT NULL, etc. to the tables.
3. Experiments based on basic DML commands – SELECT, INSERT, UPDATE and DELETE.
4. Write the queries for implementing Built-in functions, GROUP BY, HAVING and ORDER BY.
5. Write the queries to implement the joins.
6. Write the queries to implement the subqueries.
7. Write the queries to implement the set operations.
8. Write the queries to create the views and queries based on views.
9. Demonstrate the concept of Control Structures.
10. Demonstrate the concept of Exception Handling.
11. Demonstrate the concept of Functions and Procedures.
12. Demonstrate the concept of Triggers.

Paper Code(s): MAC-258	L	P	C
Paper: Thermodynamics and Applications Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Thermodynamics and Applications) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To draw the valve timing diagram of a Single Cylinder Four Stroke CI Engine.

2. To draw the valve timing diagram of a Single Cylinder Four Stroke SI Engine.

3. To conduct the performance test on the Diesel engine test rig.

4. To conduct the performance test on the Petrol engine test rig

5. To prepare heat balance sheet of single cylinder four stroke diesel engine.

6. To prepare heat balance sheet of single cylinder four stroke Petrol engine.

7. To determine Exergy destruction of Exhaust Gas Calorimeter of Petrol Engine test rig at different load.

8. To determine Exergy destruction of Exhaust Gas Calorimeter of Diesel Engine test rig at different load.

9. To determine COP of refrigeration system based on vapor compression Cycle.

10. Visit to the thermal power plant/refrigeration plant.

11. Thermodynamic analysis of Rankine cycle.

12. Comparative thermodynamic analysis of Otto, Diesel and Dual for the given condition.