w.e.f. 2020-21

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B.Tech

ELECTRICAL AND ELECTRONICS ENGINEERING

(1st,2nd & 3rd Year Scheme of Instruction & Detailed Syllabus)

Department of Electrical and Electronics Engineering

Velagapudi Ramakrishna

Siddhartha Engineering College

Kanuru, Vijayawada

Andhra Pradesh- 520007, INDIA.

www.vrsiddhartha.ac.in

V.R.SIDDHARTHA ENGINEERING COLLEGE: VIJAYAWADA
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Excel in chosen career and/or higher education.

PEO2: Exhibit professionalism, ethical, attitude, communication skills, teamwork and adapt to current trends by engaging in lifelong learning.

PEO3: Demonstrate technical competence in solving engineering problems that are economically feasible and socially acceptable.

PROGRAMME OUTCOMES

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of solutions: 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.

PO4: Conduct investigations of complex problems: 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.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: 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.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: 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.

PO11: Project Management and finance: 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.

PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Understand, analyze and design systems that efficiently generate, transmit, distribute and utilize electric power.

PSO2: To expertise in the technology associated with efficient conversion and control of electrical power to the required form.

SEMESTER-I

S.No	Course Code	Course Category	Course	L	T	P	Credits
1.	20BS1101	Basic Science	Matrices and Differential Calculus	3	0	0	**3**
2.	20BS1102	Basic Science	Engineering Chemistry	3	0	0	**3**
3.	20ES1103	Engineering Science	Programming for Problem Solving Methods	3	0	0	**3**
4.	20ES1104B	Engineering Science	Mechanics for Engineers	3	0	0	**3**
5.	20ES1105	Engineering Science	Engineering Graphics	1	0	4	**3**
6.	20BS1151B	Basic Science	Engineering Chemistry Laboratory	0	0	3	**1.5**
7.	20ES1152	Engineering Science	Programming for Problem Solving Laboratory	0	0	3	**1.5**
8	20ES1153	Engineering Science	Engineering Workshop	0	0	3	**1.5**
9	20MC1106	Mandatory Course	Technology and Society	1	0	0	**-**
			Total	14	0	13	**19.5**
10.	20MC1107	Mandatory Course	Induction Program				

Category	Credits
Basic Science Courses	3+3+1.5 = 7.5
Engineering Science Courses	3+3+3+1.5+1.5 = 12
Humanities and Social Science Courses	0
Mandatory Courses	0
TOTAL CREDITS	**19.5**

SEMESTER-II

S.No	Course Code	Course Category	Course	L	T	P	Credits
1.	20BS2101	Basic Science	Laplace Transforms and Integral Calculus	3	0	0	**3**
2.	20BS2102A	Basic Science	Engineering Physics	3	0	0	**3**
3.	20ES2103B	Engineering Science	Python Programming	3	0	0	**3**
4.	20ES2104E	Engineering Science	Network Analysis-I	3	0	0	**3**
5.	20HS2105	Humanities and Social Science	Technical English and Communication Skills	2	0	0	**2**
6.	20BS2151A	Basic Science Course	Engineering Physics Laboratory	0	0	3	**1.5**
7.	20ES2152B	Engineering Science	Python Programming Laboratory	0	0	3	**1.5**
8.	20HS2153	Humanities and Social Science	Technical English and Communication Skills Laboratory	0	0	3	**1.5**
9.	20ES2154	Engineering Science	Computing and Peripherals Laboratory	0	0	2	**1**
10.	20MC2106B	Mandatory Course	Professional Ethics and Practice	1	0	0	**-**
		Total		**15**	**0**	**11**	**19.5**

L–Lecture, **T**– Tutorial, **P** –Practical, **C**-Credits

Category	Credits
Basic Science Courses	3+3+1.5 = 7.5
Engineering Science Courses	3+3+1.5+1 = 8.5
Humanities and Social Sciences	2+1.5 = 3.5
Mandatory Courses	0
TOTAL CREDITS	**19.5**

SEMESTER– III

S.No	Course Code	Course Category	Course	L	T	P	Credits
1.	20BS3101	Basic Science	Transformation & Numerical Methods	3	0	0	**3**
2.	20EE3302	Program Core	Electronic Circuits	3	0	0	**3**
3.	20EE3303	Program Core	Electrical Machines-I	3	0	0	**3**
4.	20ES3104	Engineering Science	Network Analysis-II	3	0	0	**3**
5.	20EE3305	Program Core	Digital Electronics	3	0	0	**3**
6.	20ES3151	Engineering Science lab	Network Analysis Lab	0	0	3	**1.5**
7.	20EE3352	Program Core Lab 1	Electrical Machines –I Lab	0	0	3	**1.5**
8.	20EE3353	Program Core Lab 2	Electronic Circuits Lab	0	0	3	**1.5**
9	20TP3106	**Soft Skills – 1**	**Logic and Reasoning**	0	0	2	**1**
10.	20MC3107B	Mandatory Course (AICTE suggested)	Indian Constitution (EIE/CE/ME/EEE)	2	0	0	**-**
TOTAL				17	0	11	20.5

Category	**Credits**
Basic Science Courses	3
Engineering Science Courses	4.5
Program Core Courses	12
Skill oriented courses	1
Mandatory Courses	0
TOTAL CREDITS	**20.5**

SEMESTER-IV

S.No	Course Code	Course Category	Course	L	T	P	Credits
1.	20BS4101	Basic Science	Electrical Measurements and Sensors	3	0	0	3
2.	20EE4302	Program Core	Linear Control Systems	3	0	0	3
3.	20EE4303	Program Core	Electrical Machines-II	3	0	0	3
4.	20EE4304	Program Core	Linear Integrated Circuits and Applications	3	0	0	3
5.	20HS4105	Humanities and Social Sciences	Universal Human Values	3	0	0	3
6.	20EE4351	Program Core Lab1	Electrical Machines-II Lab	0	0	3	1.5
7.	20EE4352	Program Core Lab 2	Measurements and Control Systems Lab	0	0	3	1.5
8.	20EE4353	Program Core Lab 3	Linear Integrated Circuits Lab	0	0	3	1.5
9.	20TP4106	Soft Skills – 2	English for Professionals	0	0	2	1
10.	**20EE4607**	**Skill Oriented Course -1**	**Design Thinking**	**1**	**0**	**2**	**2**
11.	20MC4108A	Mandatory Course	Environmental Studies	2	0	0	-
			TOTAL	**18**	**0**	**13**	**22.5**

Summer Internship 6 weeks (Mandatory) during summer vacation (EPICS)				
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)	4	0	0	4

Category	**Credits**
Basic Science Courses	3
Program Core Courses	13.5
Engineering Science Courses	0
Skill Oriented courses	3
Humanities and Social Science courses	3
Mandatory Courses	0
TOTAL CREDITS	**22.5**

SEMESTER V **CONTACT HOURS: 33**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE5301	Program Core	Microcontrollers	3	0	0	3
2	20EE5302	Program Core	Power Electronics	3	0	0	3
3	20EE5303	Program Core	Power Generation and Transmission	2	0	0	2
4	20EE5404	Program Elective 1	A. Advanced Control Systems B. Solar Photovoltaics C. Artificial Neural Networks and fuzzy Logic D. Data Communication and Networking	3	0	0	3
5	20EE5205	Open Elective/Job oriented elective-1	A. Waste to Energy Conversion Technology B. Energy Conservation & Audit	3	0	0	3
6	20EE5351	Program Core Lab 1	Power Electronics Lab	0	0	3	1.5
7	20EE5352	Program Core Lab 2	Microcontrollers Lab	0	0	3	1.5
8	20EE5353	Program Core Lab 3	IoT Lab	0	0	3	1.5
9	20TP5106	**Soft Skills – 3**	Personality Development	0	0	2	1
10	20EE5354	Internship/ Project (6 weeks)	EPICS/Internship	0	0	3	1.5
11	20EE5607	**Skill Oriented Course-2**	**Data Structures Lab**	1	0	2	2
12	20MC5108B	Mandatory Course (AICTE suggested)	Innovation, IPR & Entrepreneurship	2	0	0	-
Total				**17**	**0**	**16**	**23**
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				**4**	**0**	**0**	**4**

L–Lecture, **T**– Tutorial, **P** –Practical, **C**-Credits

SEMESTER VI **CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE6301	Program Core	Power System Analysis	2	0	2	3
2	20EE6302	Program Core	Power System Protection	3	0	0	3
3	20HS6103	Humanities and Social Sciences	Engineering Economics and Management	2	0	0	2
4	20EE6404	Program Elective 2	A. Utilization of Electrical Energy B. Programmable Logic Controller C. HVDC and FACTS D. Digital Signal Processing	3	0	0	3
5	20EE6205	Open Elective-2/ Job oriented elective-2	**A. Machine Learning using Python** **B. Electric Vehicles**	3	0	0	3
6	20EE6351	Program Core Lab 1	Power Systems Lab	0	0	3	1.5
7	20EE6352	Program Core Lab 2	Simulation of Electrical Systems Lab	0	0	3	1.5
8	20HS6153	Humanities & Social Science	Advanced Communication Skills Lab	0	0	2	1
9	20TP6106	**Soft Skills –4**	Quantitative Aptitude	0	0	2	1
10	20EE6554	Internship / Project	Mini Project - I	0	0	2	1
11	20MC6107B	Mandatory Course (AICTE suggested)	A1.Foriegn Language (German) B. Biology for Engineers G.Yoga & Meditation	2	0	0	0
Total				**15**	**0**	**14**	**20**
Industrial/Research Internship six weeks (Mandatory) during summer vacation							
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0)				**4**	**0**	**0**	**4**

Category	Credits
Program Core Courses	9
Humanities and Social Sciences	3
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented courses	1
Mandatory Course	0
Internship / Project	1
TOTAL CREDITS	**20**

SEMESTER VII **CONTACT HOURS: 29**

S. No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE7301	Program Core	Power System Operation & Control	3	0	0	3
2	20EE7402	Program Elective- 3	A. Optimization Techniques B. Introduction to Smart Grid Technology C. Industrial Drives D. Advanced Power Electronics	3	0	0	3
3	20EE7403 20EE7453D	Program Elective- 4	A. VLSI design	3	0	0	3
			B. Embedded Systems	3	0	0	
			C. Digital Design with FPGA	3	0	0	
			D. Digital Controllers Lab	1	0	4	
4	20EE7404	Program Elective -5	**A. Electrical Distribution System**	3	0	0	3
			B. High-Voltage Engineering	2	0	2	
			C. Power Quality	3	0	0	
	20EE7454D		**D. PLC and SCADA Lab**	1	0	4	
5	20EE7205	Open Elective /Job oriented elective -3	MOOCS course	3	0	0	3
6	20EE7206	Open Elective /Job oriented elective -4	MOOCS course	3	0	0	3
7	20EE7607	**Skill Advanced Course**	IOT Fundamental : Connecting Things (CISCO Certification)	1	0	2	2
8	20EE7551	Internship / Project	Mini Project - II	0	0	3	1.5
9	20EE7552	Internship / Project	Industrial/Research Internship 2 Months (Mandatory) after 3rd year (to be evaluated during VII Semester)	0	0	3	1.5
Total				**19/18/15**	**0**	**8/10/16**	**23**
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2, 3-1-0 also)				**4**	**0**	**0**	**4**

Note: Open Elective Courses 3 and 4 are self-learning. Students may opt from any MOOCs platform. They have to submit the certificate before the last instruction day of VII semester.

Category	**Credits**
Program Core	3
Program Electives	9
Open Electives	6
Skill Oriented Courses	2
Internship / Project	3
TOTAL CREDITS	**23**

SEMESTER VIII CONTACT HOURS: 24

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE8551	Internship/Project**	Major Project & Internship (6 Months)	0	0	24	12
			Total	0	0	24	12

** The student should undergo internship and simultaneously he/she should work on a project with well-defined objectives. At the end of the semester the student should submit an internship completion certificate and a project report.

20BS1101-MATRICES AND DIFFERENTIAL CALCULUS

Course Category:	**Basic Sciences**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Fundamentals of Matrices, Fundamentals of Calculus, Integration, Differentiation	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Determine** Eigen values, Eigen vectors of a matrix.
CO2	**Estimate** Maxima and Minima of Multi Variable Functions.
CO3	**Solve** the Linear differential equations with constant coefficients.
CO4	**Solve** the Linear differential equations with variable coefficients.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**			**1**									
CO2	**3**	**2**			**1**									
CO3	**3**	**2**			**1**									
CO4	**3**	**2**			**1**									

Course Content

UNIT-I

Matrices: Consistency of linear system of equations, linear transformations, vectors, Eigen values, properties of Eigen values, finding inverse and powers of a matrix by Cayley-Hamilton theorem, reduction to diagonal form, reduction of quadratic form to canonical form, nature of a quadratic form, complex matrices.

UNIT-II

Differential Calculus: Fundamental Theorems-Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Expansions of functions -Maclaurin's series and Taylor's Series.

Application: Curvature, radius of curvature**.**

Functions of two or more Variables: Taylor's theorem for function of two variables, maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

UNIT-III

Differential Equations of First Order: Exact Differential Equations, equations reducible to exact equations.

Applications: Orthogonal trajectories, Newton's law of cooling.

Linear Differential Equations of Higher Order: Definitions, Operator D, rules for finding the complementary function, inverse operator, rules for finding particular integral, working procedure to solve the equation.

UNIT-IV

Method of variation of parameters, Method of undetermined coefficients, equations reducible to linear equations with constant coefficients, Cauchy's homogeneous linear equation, Legendre's linear equation, Linear dependence of solutions, simultaneous linear differential equations with constant coefficients.

Applications: L-C-R Circuits.

Text Book:

[1] B.S.Grewal , "*Higher Engineering Mathematics* ", Khanna Publishers ,44th edition, 2019.

Reference Books:

[1] Erwin Kreyszig ," Advanced Engineering Mathematics", John Wiley & Sons, 10th edition, 2015.

[2] B.V.Ramana, "*Higher Engineering Mathematics*", Tata MC Graw Hill, 1st Edition, 2007.

[3] N.P.Bali, Dr.Manish Goyal,"*A Text Book of Engineering Mathematics*", Laxmi Publications, 9th edition, 2014.

[4] Pal Bhunia , "*Engineering Mathematics* ",Oxford University Press,2015.

E-resources and other digital material

[1] www.nptel videos.com/mathematics/ (Math Lectures fromT,Stanford,IIT's)

[2] www.nptel.ac.in/courses/122104017

[3] www.nptel.ac.in/courses/111105035
Engineering Mathematics Open Learning Project.
www.3.ul.ie/~mlc/support/Loughborough%20website/

20BS1102B-ENGINEEERING CHEMISTRY

Course Category:	**Institutional core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Knowledge of Chemistry at Intermediate level	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** various water treatment methods and boiler troubles.
CO2	Apply the concept of phase equilibrium to different materials and the knowledge of working of electrodes and batteries in various technological fields.
CO3	Evaluate corrosion processes as well as protection methods.
CO4	Apply the knowledge of conventional fuels and mechanistic aspects of conducting polymers for their effective and efficient utilisation.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3												
CO2	2													
CO3			3											
CO4					2									

Course Content

UNIT-I **[Text Book -1]**

Water Technology-I: WHO standards-Water treatment for drinking purpose-sedimentation, coagulation, filtration, disinfection by chlorination, breakpoint chlorination and its significance-Desalination of brackish water-principle and process of electro-dialysis and reverse osmosis, advantages and disadvantages.

Water Technology-II: Boiler troubles-scales-formation, disadvantages and internal conditioning methods-phosphate conditioning, Calgon conditioning and sodium aluminate, sludges-formation, disadvantages and prevention, caustic embrittlement-reasons, mechanism and its control, and boiler corrosion-causes and control.

UNIT-II **[Text Book -1]**

Phase rule and applications: Definition and explanation of the terms–phase, component and degree of freedom, phase rule equation, phase equilibria of single component system–water system, two component system–silver-lead system, applications of phase rule.

Electrochemistry: Construction and working of Calomel electrode, silver-silver chloride electrode, and principle, construction and working of glass electrode, determination of pH using glass electrode. Chemistry of modern batteries-Li/$SOCl_2$ battery and $Li_xC/LiCoO_2$ battery–construction, working and advantages.

Fuel cells: General working principle of a fuel cell, examples, chemistry of H_2-O_2 fuel cell.

UNIT-III **[Text Book -1]**

Corrosion principles: Introduction, definition, reason for corrosion, examples – types of electrochemical corrosion - hydrogen evolution and oxygen absorption – corrosion due to dissimilar metals, galvanic series – differential aeration corrosion – pitting corrosion and concept of passivity.

Corrosion control methods: Cathodic protection- principle and types - impressed current method and sacrificial anode method, anodic protection-principle and method, corrosion inhibitors – types and mechanism of inhibition – principle, process and advantages of electroplating and electroless plating..

UNIT-IV **[Text Book -1]**

Conducting polymers: Definition, examples, classification-intrinsically conducting polymers and extrinsically conducting polymers- mechanism of conduction of undoped polyacetylene, doping of conducting polymers- mechanism of conduction of p-doped and n-doped polyacetylenes – applications of conducting polymers.

Fuel technology : Fuel-definition, calorific value- lower and higher calorific values and numericals on calculation of HCV and LCV relation, analysis of coal – proximate analysis and ultimate analysis, flue gas analysis by Orsat's apparatus, numericals based on calculation of air required for combustion.

Text Book:

[1] Shikha Agarwal, "*Engineering Chemistry-Fundamentals and Applications*", Cambridge University Press, New Delhi, 1st edition, 2015.

Reference Books:

[1] Sunita Rattan, "*A Textbook of Engineering Chemistry*", S.K. Kataria & Sons,New Delhi, 1st edition,2012.

[2] P.C. Jain, "*Engineering Chemistry*", Dhanpat Rai Publishing Company (P)Limited, New Delhi, 15thedition.

[3] B.S. Bahl, G. D. Tuli and Arun Bahl, "*Essentials of Physical Chemistry*", S. Chand & Company Limited, NewDelhi.

[4] O. G. Palanna*, " Engineering Chemistry*", Tata McGraw Hill Education Pvt.Ltd., New Delhi.

[5] Y.Anjaneyulu, K. Chandrasekhar and Valli Manickam, "*Text book of Analytical Chemistry",* Pharma Book Syndicate*,* Hyderabad.

[6] H. Kaur, "*Spectroscopy*", Pragati Prakashan, Meerut ,1stedition, 2001.

E-resources and other digital material

[1] http://www.cip.ukcentre.com/steam.htm

[2] http://corrosion-doctors.org/Modi;es/mod-basics.htm

[3] http://nopr.niscair.res.in/bitstream/123456789/5475/1/JSIR20715-728.pdf

[4] https://chem.libretexts.org/core/Analytical_Chemistry/ Electrochemistry/ Basics_of _Electrochemistry

[5] http: //www.filtronics.com/blog/tertiary-treatment/stages-in-typical-municipal-water-treatment/

[6] NPTEL online course, "Corrosion Part-I" offered by MHRD and instructed by Prof. Kallol Mondal of IIT Kanpur

20ES1103- PROGRAMMING FOR PROBLEM SOLVING

Course Category:	**Institutional core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the different types of problem solving approaches.
CO2	**Apply** the selections, loops, arrays, and string concepts in C to solve problem
CO3	**Apply** functions and pointer concepts in C to solve problem
CO4	**Solve** problems using enum, structures, unions, and file handling functions.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1												
CO2		2	3										2	
CO3		2	3										3	
CO4		2	3										3	

Course Content

UNIT-I **[Text Book-1]**

Introduction to computer-based problem solving: Requirement of problem solving by computers, problem definition, Use of examples for problem solving, similarities between problems, Problem solving strategies, steps involved in problem solving.

Program design and implementation issues: programs and algorithms, top-down design and step-wise refinement, construction of loops-basic programming constructs, Implementation, programming environment.

Algorithms for problem solving: Exchanging values of two variables, Summation of a set of numbers, decimal to binary base conversion, reversing the digit of an integer, to find greatest common divisor (GCD) of two numbers, to verify whether an integer is prime or not, organize a given set of numbers in ascending order, find the square root of an integer, factorial of a given number, generate the Fibonacci sequence for n terms, evaluate sin(x) as sum of series, to find the value of the power of a number raised by another integer, reverse order elements of an array, find largest number in an array, print elements of upper triangular matrix, multiplication of two matrices, to compute to roots of a quadratic equation $ax^2+bx+c=0$.

UNIT-II **[Text Book-1]**

Introduction to the C Language: Background of C program, identifiers, types, variables, constants, memory layout, input/output, programming examples.

Structure of a C Program: Logical data and operators, expressions, precedence and associatively, evaluating expressions, type conversion, statements, storage class.

Selection: Two-way selection, multi-way selection, more standard functions.

Repetition: Concept of a loop loops in C, loop examples, recursion, the calculator program.

Arrays: Array concepts in C, inter-function communication, array applications, two dimensional arrays, multi-dimensional arrays.

UNIT-III **[Text Book-1]**

Strings: String Concepts, C Strings, String input/output functions, arrays of strings, string manipulation functions, string- data conversion.

Functions: Functions in C, user defined functions, call by value, call value reference, inter-function communication, standard functions, scope.

Pointers: Introduction to pointer, pointers for inter-function communications, pointers to pointers, compatibility, L value and R value.

Pointer Applications: Arrays and pointers, pointer arithmetic and arrays, passing an array to a function, memory allocations functions, array of pointers.

UNIT-IV **[Text Book-2]**

Enumerations: The type definition (Typedef), enumerated types-declaring an enumerated type , operations on enumerated types, enumeration type conversion, initializing enumerated constants, anonymous enumeration: constants, input/output operators.

Structures: Structure type declaration, initialization, accessing structures, operations on Structures, Complex Structures, structures and functions, sending the whole structure, passing structures through Pointers.

Unions: Referencing unions, initializers, unions and structures, internet address, programming Applications.

File Handling: Files, streams, standard library input/output functions, formatting input/output functions and character input/output functions, command-line arguments.

Text Books:

[1] HarshaPriya, R. Ranjeet , " *Programming and Problem Solving Through "C" Language* ", Firewall media ,2006.

[2] Behrouz A. Forouzan and Richard F. Gilberg , " *Computer Science A Structured Programming Approach Using C* ", CENGAGE Learning ,3rd edition.

Reference Books:

[1]. Anil B. Chaudhuri, "*Flowchart and Algorithm Basics: The Art of Programming*", Mercury Learning & Information, 2020.

[2]. R.G. Dromey, "*How to Solve it By Computer*", Prentice-Hall International Series in Computer Science,1982.

[3]. YashwantKanetkar , "*Let us C*" , BPB Publications, 16th Edition 2017.

[4]. Kernighan and Ritchie,"The C programming language", The (Ansi C Version), PHI, second edition.

[5]. Paul J. Dietel and Harvey M. Deitel, "C: *How to Program*", Prentice Hall, 8th edition (Jan 19 ,2021).

[6]. K.R.Venugopal, Sundeep R. Prasad, "*Mastering C*", McGraw Hill, 2nd Edition, 2015.

E-resources and other digital material

[1] Computer Science and Engineering - Noc:problem Solving Through Programming in C. [online] https://nptel.ac.in/courses/106/105/106105171/

[2] Computer Science and Engineering - Noc:introduction To Programming in C. [online] https://-nptel.ac.in/courses/106/104/106104128/

[3] C For Everyone: Structured Programming. [online]https://www.coursera.org/learn/c-structured -programming

[4] Advanced C Programming CourseTim Academy-Jason Fedin. [online] https://www.udemy.com/-course/advanced-c-programming-course/

17ME1104B-MECHANICS FOR ENGINEERS

Course Category:	**Engineering Sciences**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Basic Mathematics, Physics	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	Apply equilibrium equations to analyze planar concurrent and parallel forces
CO2	Analyze coplanar general case of force systems.
CO3	Evaluate centroids and determine Area moment of inertia of plane figures
CO4	Evaluate the moment of inertia of material bodies and analyze the fixed axis rotation of rigid bodies.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**1**												**1**
CO2	**2**	**1**												**1**
CO3	**2**													**1**
CO4	**2**	**1**												**1**

Course Content

UNIT-I **[Text Book-1&2]**

Concurrent forces in a plane: Principles of statics, force, addition of two forces- parallelogram law-composition and resolution of forces-constraint, action and reaction, types of supports and support reactions, free body diagram, equilibrium of concurrent forces in a plane-method of projections-moment of a force, theorem of varignon, method of moments.

Parallel forces in a plane: Introduction, types of parallel forces, resultant, couple, resolution of force into force and a couple, general case of parallel forces in a plane.

UNIT-II **[Text Book-1&2]**

General case of forces in a plane: Composition of forces in a plane-equilibrium of forces in a plane, plane trusses-method of joints.

Friction: Introduction, classification of friction, laws of dry friction, co-efficient of friction, angle of friction, angle of repose, cone of friction, wedge friction.

UNIT-III **[Text Book-1]**

Centroids: Determination of centroids by integration method, centroids of composite plane figures.

Area moment of inertia of plane figures: Moment of Inertia of a plane figure with respect to an axis in its plane, Moment of Inertia with respect to an axis perpendicular to the plane of the figure, Parallel axis theorem, Moment of inertia for composite areas

UNIT-IV **[Text Book-1&2]**

Moment of inertia of material bodies: Moment of inertia of a rigid body-moment of inertia of laminas-slender bar, rectangular plate, circular plate, circular ring, moment of inertia of 3D bodies-cone, solid cylinder, sphere & parallelepiped.

Kinematics of a rigid body in rotation about a fixed axis: Kinematics of rotation.

Kinetics of a rigid body in rotation about a fixed axis: Equation of motion for a rigid body rotating about a fixed axis-rotation under the action of a constant moment.

Text Books:

[1] S.Timoshenko, D.H.Young, J.V.Rao & Sukumar Pati, " *Engineering Mechanics*", Tata Mc. Graw Hill Pvt. Ltd, 5th edition, 2013(For Concepts and symbolic Problems).

[2] A.K.Tayal , " *Engineering Mechanics Statics and dynamics* ", Umesh Publications , 13th edition, 2006 (For numerical Problems using S.I.System ofUnits).

Reference books:

[1] Andrew pytel & Jaan Kiwsalaas , " *Engineering Mechanics: Statics and Dynamics* ", Cenage Learning, 3rd edition, 2013.

[2] SS Bhavikatti and KG Rajasekharappa, "*Engineering Mechanics*", New Age International Private Limited, 4th edition, 2012.

[3] Beer and Johnston, "*Vector Mechanics for Engineers Statics andDynamics*", Tata Mc. Graw Hill Pvt Ltd, 3rd edition, 2010.

E-resources and other digital material

[1] http://emweb.unl.edu

[2] https://nptel.ac.in/courses/122/104/122104015/

20ES1105-ENGINEERING GRAPHICS

Course Category:	**Institutional Core**	**Credits:**	4
Course Type:	Theory and practice	**Lecture-Tutorial-Practice:**	2-0-4
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the Scales and conics.
CO2	**Draw** Orthographic projections of points, Lines and Planes.
CO3	Draw Orthographic projections of solids and to understand basics of Auto CAD.
CO4	Understand the sections, developments of solids and draw isometric views using Auto CAD.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**		3						**3**					
CO2	**2**		3						**3**					
CO3	**2**		3						**3**					
CO4	**1**		3						**3**					

Course Content

UNIT-I **[Text Book-1]**

Introduction to Engineering Drawing: Principles of engineering graphics and their significance.

Scales: Construction of plain and diagonal Scales.

Conic Sections: Construction of ellipse, parabola and hyperbola (Treatment is limited to Eccentricity or General method only).

UNIT-II **[Text Book-1]**

Orthographic Projections: Principles of orthographic projections-projections of points, lines (treatment is limited to first angle projection) and projections of plane regular geometric figures (up to plane inclined to both of the reference planes).

UNIT-III **[Text Book-2]**

Projections of Solids: Projections of simple solids such as cubes, prisms, pyramids, cylinders and cones with varying positions (limited to solid inclined to one of the reference planes).

Introduction to Auto CAD: Basic introduction and operational instructions of various commands in Auto-CAD **(**Internal Evaluation only**)**.

UNIT-IV **[Text Book-1&2]**

Sections and Development of Surfaces of Right Angular Solids:

Sections and sectional views of right angular solids of Prism, Pyramid and Cone, Development of surfaces of Right Regular Solids of Prism, Pyramid and Cone.

Isometric Projections: Conversion of isometric views into Orthographic Projections of simple castings using

Auto CAD (Treatment is limited to simple objects only, Internal Evaluation only).

Text Books:

[1] Basanth Agrawal & C M Agrawal, " *Engineering Drawing*", McGraw Hill Education Private Limited, New Delhi , Latest edition.

[2] N.D. Bhatt & V.M. Panchal, "*Elementary Engineering Drawing*", Charotar Publishing House, 49th edition, 2006.

Reference Books:

[1] K. L. Narayana & P. Kannaiah, "*Text Book on Engineering Drawing*", Scitech publications (India) Pvt. Ltd., Chennai, 2nd edition, 2006.

[2] K. Venugopal, "*Engineering Drawing and Graphics plus Auto CAD*", New Age International, NewDelhi, Latest edition.

[3] D M Kulkarni, AP Rastogi, AK Sarkar, "*Engineering Graphics with Auto CAD*", Prentice Hall of India Pvt. Ltd., Delhi, Latest edition, 2013.

E-resources and other digital material

[1] http://www.youtube.com/watch?v=XCWJ XrkWco, Accessed On 01-06-2017.

[2] http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html# isodrawing, Accessed On 01-06-2017.

[3] http://www.slideshare.net, Accessed On 01-06-2017

[4] http://edpstuff.blogspot.in, Accessed On 01-06-2017

20BS1151B-ENGINEERING CHEMISTRY LABORATORY

Course Category:	**Institutional Core**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Knowledge of chemistry practical at intermediate level.	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** ores, commercial samples, quality parameters of water samples from
CO2	**Perform** quantitative analysis using instrumental methods.
CO3	**Apply** the knowledge of preparation of polymers, separation of ions, mechanism of

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		**3**												
CO2					**2**									
CO3	**2**													

Course Content

List of Experiments:

1. Determination of MnO_2 in Pyrolusite / Iron in Haematite ore
2. Determination of total alkalinity of a water sample
3. Determination of purity of a boric acid sample
4. Conductometric analysis of a strong base using a strong acid
5. Determination of total hardness of a water sample
6. Determination of copper in a given sample
7. Chemistry of blueprinting
8. Determination of Mohr's salt - Permanganometry
9. Determination of Mohr's salt - Dichrometry
10. Comparison of corrosion rates of different metals
11. Determination of available chlorine in a bleaching powder sample
12. Determination of chlorides in a water sample
13. pH metric analysis of a strong base using a strong acid
14. Preparation of urea-formaldehyde resin
15. Separation of ions by paper chromatography

Reference Books :

[1] S.K. Bhasin and Sudha Rani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 2nd edition.

[2] Sunitha Rattan, "Experiments in Applied Chemistry", S.K. Kataria & Sons, New Delhi, 2nd edition

20ES1152

PROGRAMMING FOR PROBLEM SOLVING LABORATORY

Course Category:	Engineering Science	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	---	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Implement the use of programming constructs in a structural programming language.
CO2	Apply the selections, loops, arrays, and string concepts in C to solve problems.
CO3	Apply functions, pointer, and Enum concepts in C to solve problems.
CO4	Solve problems using structures, Unions, and file handling functions.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1		3											
CO2		1	3										1	
CO3		1	3										3	
CO4		1	3										3	

COURSE CONTENT

WEEK – 1 : Introduction to C Programming

a) The Structure of C Program with a sample program.
b) Use identifiers, data types, format specifiers, constants, and variables declaration and initialization to write simple C programs.
c) Write simple C programs using preprocessor commands and simple I/O statements.

WEEK – 2 : Data Types and Variable Declarations

a) Use void, integral and floating point data types in different scenarios to write programs.
b) Use various primitive data types for performing different mathematical operations.
c) Programs to perform mathematical operations using various operators in C

WEEK – 3 : Selection – Making Decisions

a) Write programs using the if...else selection statements.
b) Use nested if...else statement to solve problems that need multi-level selection making decisions.
c) Write programs that use switch...case and else...if multi way statements to select one out of several options.

WEEK – 4 : Looping Constructs and Their Applications

a) To have a clear idea on loop initialization, validation and updation.
b) Write programs using the while, for, or do...while loops.
c) To understand the logic and adopt best looping construct for different kinds of problems.
d) Design and develop programs based on Iterative loops using While, Do While, For, Nested For.

WEEK – 5 : Unconditional Control Transfer Statements

a) Write programs using of (break, and continue) unconditional control transfer statements.
b) Use the goto statement to transfer the control from one part to another part of a program and the use of return statement to end the execution of a called function.

WEEK – 6 : Arrays and Their Applications

a) To utilize one dimensional and multi-dimensional array to solve problems that use set(s) of similar type input data.
b) To write programs that performs multiple classical operations like searching, sorting, updation, or deletion on array elements.

WEEK – 7 : Strings, String I/O and Manipulation Functions

a) To write programs that work on read, write and manipulate fixed length and variable-length strings and/or arrays of strings
b) To write programs that use predefined string I/O functions.
c) To write programs that use string manipulation functions from the string library.

WEEK – 8 : Concepts of User Defined Functions

a) Design and develop programs depending on functions both user defined andstandard library functions in C with different approaches.
b) To write a program using more than one function with or without parameters and function return type.

WEEK – 9 : Pointers and Their Applications

a) Programs on declaration of pointers and their usage in C.
b) Programs to relate between arrays and pointers and use them efficiently in a program.
c) To pass pointers as an argument to a function, and use it efficiently in a program.
d) To write programs using static and dynamic memory allocation.

WEEK – 10 : Structure, Union, and Enumeration

a) Programs to define, declare and access structure and union variables
b) Design and develop programs to work with pointers to access data within a structure
c) Programs to pass structure as an argument to a function
d) To write C programs using enumeration data types, an easiest way of mapping symbolic names to integer values.

WEEK–11 : File Handling Operations

a) Programs to open and close text and binary files using file I/O commands.
b) Write programs to perform read and write operations using the formatting I/O and character I/O functions.
c) Apply file positioning, status and system commands based on a problem requirements.

WEEK – 12 : Command Line Arguments

a) To use command line arguments to pass inputs in a single line while executing a program through the DOS command prompt or Linux terminal.
b) To use atoi function to convert a default string value argument to an integer value inside the main

function in a program.

c) To use at of function to convert a default string value argument to a float value inside the main function in a program.

Text Book(s)

[1] Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science A Structured Programming Approach Using C", CENGAGE Learning, Third Edition.

REFERENCE BOOKS

[1] Anil B. Chaudhuri, "*Flowchart and Algorithm Basics: The Art of Programming*", Mercury Learning & Information, 2020.
[2] R.G. Dromey, "*How to Solve it By Computer*", Prentice-Hall International Series in Computer Science,1982.
[3] Yashwant Kanetkar , "*Let us C*" , BPB Publications, 16th Edition 2017.
[4] Kernighan and Ritchie,"*The C programming language*", The (Ansi C Version), PHI, second edition.
[5] Paul J. Dietel and Harvey M. Deitel, "C: *How to Program*", Prentice Hall, 8th edition (Jan 19, 2021).
[6] K.R.Venugopal, Sundeep R. Prasad, "*Mastering C*", McGraw Hill, 2nd Edition, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1] Computer Science and Engineering - Noc:problem Solving Through Programming in C. [online] https://nptel.ac.in/courses/106/105/106105171/

[2] Computer Science and Engineering – Noc :introduction To Programming in C. [online] https://-nptel.ac.in/courses/106/104/106104128/

[3] C For Everyone: Structured Programming. [online]
https://www.coursera.org/learn/c-structured -programming

[4] Advanced C Programming Course Tim Academy-Jason Fedin. [online] https://www.udemy.com/-course/advanced-c-programming-course/

ENGINEERING WORKSHOP
20ES1153 / 20ES2153

Course Category:	Engineering Sciences	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring.
CO2	Prepare basic models using sheet metal and practice joining of metals using arc welding technique.
CO3	Familiarize with various manufacturing processes such as injection moulding and 3D printing
CO4	Understand the preparation of PCB
CO5	Understand simple IOT Applications using Arduino

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1			**2**					**1**			**3**	**2**		**2**
CO2			**2**					**1**			**3**	**2**	**2**	**2**
CO3			**2**					**1**			**3**	**2**		
CO4						**1**							**1**	**1**
CO5							**2**						**1**	**1**

COURSE CONTENT

PART-A

Carpentry:

a. Demonstration of Cross half lap and T joints. (1 class)
b. Demonstration of power tools.

Electrical Wiring:

a. Fundamentals of Electric wiring and practice of Series wiring. (1 class)

b. Practice of stair case wiring and connecting a fluorescent Tube.

Sheet metal & soldering:

a. Preparation of complete funnel using sheet metal and practice of soldering. (2 classes)

b. Preparation of a square box using sheet metal and practice of soldering.

Welding:

a. Preparation of Corner Joint using arc welding process. (1 class)

b. Preparation of "T" joint using arc welding process.

Manufacturing processes:

a. Preparation of a small plastic part using injection moulding process. (1 class)

b. Demonstration of manufacturing a simple model using 3D printing process.

Electronic Circuits:

1. **To prepare PCB for the given electronic circuit**
   a. To prepare the layout and printing it on copper clad board
   b. To etch and drill the holes on PCB (2 classes)

2. **To solder the components on the PCB prepared and test the circuit**
   a. To identify and solder the components on the PCB prepared
   b. To test the operation of the circuit.

Basic IOT:

1**. Demonstration of Arduino board**
   a. Demonstrate different components & pin configuration of Arduino
   b. To set up Arduino IDE for programming.

2.**To measure Temperature & Humidity**

a. Interfacing of temperature & humidity sensor with Arduino. (2 classes)

b. Execute the program on Arduino IDE & display the measured values.

3. **To measure Distance**

a. Interfacing of Ultrasonic Sensor with Arduino

b. Execute the program on Arduino IDE & display the measured value.

PART-B

GROUP ACTIVITY (4 classes)

Students must prepare a Working model / Assembly using the knowledge gained from the above trades.

TEXT BOOKS

[1] Kannaiah P. & Narayana K. C., "Manual on Workshop Practice", Scitech Publications, Chennai, 1999.

[2] Venkatachalapathy, V. S., "First year Engineering Workshop Practice", Ramalinga Publications, Madurai, 1999.

REFERENCE BOOKS

[1] Gopal, T.V., Kumar, T., and Murali, G., "A first course on workshop practice – Theory, Practice and Work Book", Suma Publications, Chennai, 2005

E-RESOURCES AND OTHER DIGITAL MATERIALL

1. https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17- 1.pdf
2. https://www.protosystech.com/rapid-prototyping.htm

3. https://www.arduino.cc/en/Tutorial/Foundations
4. https://www.tutorialspoint.com/arduino/

20MC1106A-TECHNOLOGY AND SOCIETY

Course Category:	**Institutional Core**	**Credits:**	-
Course Type:	Theory(Mandatory Learning)	**Lecture-Tutorial-Practice:**	1-0-0
Prerequisites:		**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	100M - 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the origins of technology and its role in the history of human progress.
CO2	**Know** the industrial revolution and its impact on society.
CO3	**Interpret** the developments in various fields of technology till twentieth century.
CO4	**Distinguish** the impacts of technology on the environment and achievements of great scientists.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**							1				**1**		
CO2	**3**				2		**1**							
CO3	**3**							1				**1**		
CO4	**3**				2		**1**							

Course Content

UNIT-I **[TextBook-1]**

Introduction: Origins of technology, the agriculture revolution, technological contributions of ancient civilizations- Mesopotamian, Egyptians, Greeks, Romans, Indians and Chinese.

UNIT-II **[Text Book-1]**

Industrial revolution: The social and political background, the technical background, steam-the power behind the industrial revolution, the revolution in textile industry, the impact of industrial revolution on society.

UNIT-III **[Text Book-1]**

The Flowering of modern technology: Manufacturing technologies, prime movers, and internal combustion engines, production of metals and alloys, the birth of electrical technology, twentieth century-the flowering of modern technology.

UNIT-IV **[Text Book-1]**

Technology, Science and Society: Impact of technology on society, the impacts of technology on the environment, sustainable development.

Achievements of famous scientists:

(**World**): Einstein, Newton, Faraday, Graham Bell, Edison, S. Hawking.

(**India**): CV Raman, S.Chandrasekhar, Aryabhatta, Homi J Bhabha, Vikram Sarabhai, APJ Abdulkalam,

S.Ramanujan, M.Visweswarayya.

Text Book:

[1] Dr. R.V.G Menon, "*Technology and Society*", Pearson Education, Second edition, 2011.

Reference Book:

[1] Quan-Haase, A., "*Technology and Society: Inequality, Power, and Social Networks*", Oxford University Press, 2013.

20BS2101-LAPLACE TRANSFORMS AND INTEGRAL CALCULUS

Course Category:	**Institutional core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Vectors, Integration and Curve Tracing.	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Solve** linear differential equations using Laplace Transforms.
CO2	**Evaluate** areas and volumes using double, triple integrals.
CO3	Evaluate grad, div & curl of scalar and vector point functions.
CO4	**Convert** line integrals to area integrals and surface integrals to volume integrals.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**2**			**1**									
CO2	**3**	**2**			**1**									
CO3	**3**	**2**			**1**									
CO4	**3**	**2**			**1**									

Course Content

UNIT-I **[Text Book-1]**

Laplace transforms: Introduction, definition, conditions for existence, transforms of elementary functions, properties of Laplace transforms, transforms of periodic functions, transforms of derivatives, transforms of integrals, multiplication by t^n, division by t, Inverse transforms-method of partial fractions, other methods of finding inverse transform, convolution theorem, unit step and unit impulse functions.

Applications: Evaluation of integrals, solving differential equations by Laplace transform.

UNIT-II **[Text Book-1]**

Integral calculus: Double integrals, change of order of integration, double integrals in polar coordinates, triple integrals, change of variables.

Applications: Area enclosed by plane curves, volumes of solids.

UNIT-III **[Text Book-1]**

Vector Differential Calculus: Scalar and Vector point functions, Del applied to Scalar point functions-Gradient, Del applied to Vector point functions, Physical interpretation of Divergence and Curl, Del applied twice to point functions, Del applied to products of point functions.

UNIT-IV **[Text Book-1]**

Vector Integral Calculus: Integration of vectors, line integral, surface integral, Green's Theorem in the plane, Stokes's Theorem, Volume integral, Gauss Divergence Theorem, irrotational fields.

Text Book:

[1] B.S.Grewal, "*Higher Engineering Mathematics*", Khanna Publishers, 43rd edition, 2014.

Reference Books:

[1] Erwin Kreyszig , "*Advanced Engineering Mathematics*" , John Wiley & Sons, 10th edition, 2015
[2] B.V.Ramana, "*Higher Engineering Mathematics*", Tata MC Graw Hill, 1st edition,2007
[3] N.P.Bali, Dr.Manish Goyal, "*A Text Book of Engineering Mathematics*", Laxmi Publications, 9th edition, 2014.

E-resources and other digital material

[1] www.nptel videos.com/mathematics/ (Math Lectures from MIT,Stanford,IIT"S)
[2] www.nptel.ac.in/courses/122104017
[3] www.nptel.ac.in/courses/111105035
[4] Engineering Mathematics Open Learning Project.: www.3.ul.ie/~mlc/support/Loughborough%20website/

20BS2102A- ENGINEERING PHYSICS

Course Category:	Institutional Core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0 - 0
Prerequisites:	10 + 2 level Physics	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Employ physical laws of electrostatics and compute problems related to static electric fields.
CO2	Illustrate the laws of magnetostatics and solve various problems involving static magnetic fields.
CO3	Describe various types of electric and magnetic materials.
CO4	Understand the time varying electric and magnetic fields by applying appropriate Maxwell's equations.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2										
CO3	3											
CO4	3	1										

COURSE CONTENT

UNIT – I : Electrostatics

Electrostatics: Coulomb's Law and Field Intensity, Electric Field due to Continuous Charge Distributions, Electric Flux Density, Gauss's Law, Applications of Gauss Law- Line charge, Surface charge, Volume charge, Electric Potential, Relation between E and V, Maxwell's Equation for static electric fields (Qualitative), Potential and Field of Electric Dipole, Energy Density in Electrostatic Fields.

UNIT – II : Magnetostatics

Magnetostatics: Biot-Savart's Law, Ampere's circuit law-Maxwell's equation, Applications of Ampere's law-Infinite line Current, Infinite sheet of current, Magnetic flux density-Maxwell's equation for static magnetic field, Magnetic Vector and Scalar potentials, Force due to magnetic fields - Force on a charged particle, Current element, Force between two current elements, Magnetic dipole, Magnetic Energy.

UNIT – III : Types of Electric and Magnetic Materials

Types of Electric and Magnetic Materials: Properties of electric materials- Conductors and Dielectrics, Convection and Conduction Currents, Polarization in Dielectrics, Dielectric Constant and Strength, Continuity Equation and Relaxation Time, Poisson's and Laplace's Equations, Electro static boundary conditions: Dielectric-Dielectric, Conductor-Dielectric, Conductor-Free Space. Types of magnetic materials, Magnetization in Materials, Magnetic boundary conditions.

UNIT – IV : Time Varying Fields and Electro Magnetic Waves

Time Varying Fields: Faraday's Law, Transformer and Motional Electro motive Forces, Displacement Current, Maxwell's Equations in Final Forms, Time Harmonic Fields.

Electro Magnetic Waves: Wave propagation in lossy dielectrics, lossless dielectrics, free space, good conductors, Poynting Theorem.

TEXT BOOKS

[1]. Resnick, Halliday and Krane, "Physics", 5th edition, Wiley India Pvt. Ltd, New Delhi, 2016.

[2]. Matthew N. O. Sadiku, "Principles of Electromagnetics", 4th edition, Oxford University Press, New Delhi, 2009.

REFERENCE BOOKS

[1]. R.K. Gaur and S.L. Gupta, "Engineering Physics", 8th Edition Reprint,Dhanpat Rai Publications (P) LTD., New Delhi, 2013

[2]. W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", 7th edition, Tata McGraw Hill, New Delhi, 2006

[3]. Joseph A. Edminister, "Electromagnetics – Theory and problems", 2nd edition, Schaum's outline series, MCGraw Hill,1993

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. http://nptel.iitm.ac.in/video.php?subjectId=10810607
2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm
3. http://www.mike-willis.com/Tutorial/PF2.htm

20ES2103B- PYTHON PROGRAMMING

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3- 0 - 0
Prerequisites:	20ES1103Programming for Problem Solving 20ES1152Programming for ProblemSolving Laboratory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Interpret the python syntax and semantics of control flow statements
CO2	Apply functions and modules in Python to solve a problem
CO3	Apply 3rd party packages for developing solutions for real time problems.
CO4	Implement the problems in terms of real world objects using OOPs concept.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO2
CO1	3	2	2						2			3	2	1
CO2	2	2	2						2			3	1	2
CO3	2	2	2						2			3	3	2
CO4	2	2	2						2			3	3	1

COURSE CONTENT

UNIT I

Introduction: History-Origins of python, Features of Python- why choose python, what can I do with python, Installing, Python 2 & 3 installation on windows

Variables, Expressions & Statements: Variables, Variable names & keywords, Operators & operands, Expressions, Order of operations, Modulus Operator, String Operations.

Conditional Execution: Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, exceptions using try and except, Short circuit evaluation of logical expressions.

Iterations: The while statement, Infinite loops, "Infinite loops" and break, finishing iterations with continue, Definite loops using for.

UNIT II

Functions: Function Calls, Built-in functions, type conversion functions, random numbers, math functions, adding new functions, definition and uses, flow of execution, parameters & arguments, fruitful and void functions, why functions?, recursion, scope of a variable.

Modules: Packages small description about modularity, Third Party Packages, A brief tour of standard library, command line arguments, Error output redirection and program termination, String pattern matching, Mathematics, Internet Access, Dates & times, Data Compressions.

UNIT III

Lists: Syntactically, accessing element from list, slicing a list, lists are mutable sequences, deleting items in a list and deleting list, methods, searching

Dictionaries: Creating a dictionary, Dictionary operations, Dictionary methods,
Aliasing and copying

Tuples: Tuples are immutable, comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignment with dictionaries, Using tuples as keys in dictionaries

Strings: A string is a sequence, Getting the length of a string using len, Traversal through a string with a loop, String slices, Strings are immutable, Looping and counting, The in operator, String comparison, string methods

Sets: Modifying a Set, removing items from set, set operations.

UNIT IV

Object Oriented Programming in Python: Python Classes, Methods, Constructors, Class variables & Instance Variables, Basic inheritance, Special methods, Data Hiding.

TEXT BOOKS:

[1]. VamsiKurama, "Python Programming: A Modern Approach", Pearson India, 2017.

[2]. Charles Severance, " Python for Informatics- Exploring Information", 1st edition Shroff Publishers, 2017.

REFERENCE BOOKS:

[1]. Mark Lutz,"Learning Python", 5th edition, Orielly, 2013.

[2]. Allen Downey "Think Python, How to Think Like a Computer Scientist",2nd edition, Green Tea Press, 2015.

[3]. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006.

[4]. Kenneth A. Lambert, "Introduction to Python", 1st edition, CengageLearning, 2011.

E-resources and other digital material:

[1]. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: https://www.coursera.org/

[2]. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), Available:https://nptel.ac.in/courses/106/106/106106182/#

[3].Charles Russell Sevarance, University of Michigan, Python for Everybody, 2019
https://www.coursera.org/learn/python

20ES2104E- NETWORK ANALYSIS-I

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3 - 0 - 0
Prerequisites:	Physics	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Understand DC and AC circuit concepts.
CO2	Apply network theorems for circuit analysis.
CO3	Understand series and parallel resonance concepts and analyze coupled circuits.
CO4	Analyze poly-phase circuits and apply different power measurement techniques.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3			2								1	
CO2	3	3											1	
CO3	2	3			2								1	
CO4	2	3											1	

COURSE CONTENT

UNIT-I **[Text Book-1]**

Basic components and electric circuits: Charge, current, voltage and power, voltage and current sources-independent and dependent sources, ohm's law, series and parallel connected sources, circuit elements-resistance, inductance and capacitance, series and parallel combination of circuit elements, star-delta transformations, voltage and current division, source transformations, power & energy calculations.

Sinusoidal steady state analysis: Introduction, characteristics of sinusoids, Steady state response to sinusoidal functions, complex forcing functions, phasor, phasor relationship for R, L and C series RL circuit, RC circuit and RLC circuit, parallel AC circuits, impedance, admittance, Kirchhoff's voltage and current laws, basic mesh and super mesh analysis, basic nodal and super node analysis. Instantaneous power, average power, calculation of average power for periodic wave forms, effective values of current and voltage, complex power.

UNIT-II **[Text Book-1]**

Network Theorems to DC & AC Circuits: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem and Compensation theorem.

UNIT-III **[Text Book-1]**

Series and Parallel Resonance: Series resonance, resonant frequency, voltages and currents in a series resonant circuit, bandwidth of an RLC series circuit, quality factor (Q) and its effect on bandwidth, magnification in series resonance, parallel resonance, resonant frequency of parallel RLC circuit, reactance curves in parallel resonance, Q factor of parallel resonance, bandwidth of parallel RLC circuit, resonant frequency for a tank circuit, magnification in parallel resonance.

Coupled Circuits: Introduction-self-inductance, mutual inductance, coefficient of coupling, inductances in series and parallel, dot convention, coupled circuits, conductively coupled equivalent circuits.

UNIT-IV **[Text Book-1&2]**

Poly-phase Circuits: Poly-phase system, advantages of three-phase system, generation of three-phase voltages, phase sequence, inter connection of three-phase sources and loads, voltage, current and power in a star connected system, voltage, current and power in a delta connected system, three-phase balanced and unbalanced circuits.

Power Measurement in Three-Phase Circuits: Power in three phase circuits-two wattmeter and three watt meter methods, power factor of balanced circuits by two watt meter method, variation in watt meter readings with load power factor (lag and lead p.f. loads), measurement of reactive power with two watt meter.

TEXT BOOKS

[1] W.H.Hayt, J.E.kemmerly and S.M.Durbin, "*Engineering Circuit Analysis*", Tata Mc.Graw-Hill, New Delhi 8th edition,2012.

[2] A.Chakrabarti.," *Circuit Theory (Analysis and Synthesis*",DhanpatRai& Co. Delhi,6th edition,2010.

REFERENCE BOOKS

[1] Charles K. Alexander, Matthew N. O. Sadiku , "*Fundamentals of. Electric Circuits"*, McGraw-Hill,New York, 5th edition, 2013.

[2] Ravish R Singh, "*Network Analysis and Synthesis"*, McGraw-Hill Education (India) Pvt. Ltd., 1st edition, 2013.

[3] A.Sudhakar and ShyammohanS.Palli , "*Circuits & Networks Analysis and Synthesis"* Tata McGraw-Hill, New Delhi , 3rd edition,2007.

[4] Van valeken berg, "*Network Analysis and Synthesis",*Prentice Hall of India,3rd edition.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://nptel.ac.in/courses.php?branch=eee

[2] http://ocw.mit.edu/courses/audio-video-courses/#electrical-engineering-and-computer-science.

20HS2105- TECHNICAL ENGLISH AND COMMUNICATION SKILLS

Course Category:	Institutional Core	**Credits:**	2
Course Type:	Theory	**Lecture -Tutorial-Practice:**	2 - 0 - 0
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Develop administrative and professional compilations with felicity of expression
CO2	Demonstrate Proficiency in advanced reading and context oriented writing
CO3	Apply the elements of functional English with sustained understanding for authentic use of language in any given academic and/or professional environment
CO4	Execute tasks in Technical communication with competence

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**2**				**3**		
CO2						**2**			**2**	**3**		
CO3						**2**			**2**	**3**		
CO4										**3**		

COURSE CONTENT

UNIT I

Professional Writing Skills:-

Professional Letters:

Business, Complaint and Transmittal – Purpose, Style and format with special reference to Block Format and Modified Block Format

Paragraph and Essay Writing:

Linkers , Descriptive and Analytical with illustrations

Effective writing Practice-

Appropriateness. Brevity, clarity, cogency and coherence with guided and semi-controlled compilations including the use of Idiomatic expressions

UNIT II

Reading comprehension and Discourse development Skills

Analytical and critical reading - critical, creative and lateral thinking- language and thinking –

thinking process and language development.

Effective reading Strategies - Skimming, Scanning, Eye span, fixation, taming Regression, and Issues and Challenges of Vocalization and sub-vocalization.

Context-oriented Dialogue/ Argument writing - Extending Invitation, Reciprocation, Acceptance,
Concurrence, Disagreeing without being disagreeable- Discourse/dialogue
Development and identification of inconsistencies in pre-prepared dialogues

UNIT III

Vocabulary and Functional English

Vocabulary for Competitive examinations (A list of 500 High frequency words) Synonyms Antonyms, Matching Homonyms, Homophones and nearer words along with Root words

Verbal analogies(Single Unit) – Synonym Relation, Antonym relation, Object- Operator relation, Object-Obstacle/obstruction relation, Sequence Relation, Place-Monument Relation, Science- area of activity relation, Profession- Tool relation, Gender relation, Diminutive relation, etc

Functional Grammar with special reference to Tense, Concord, Articles, pronoun-referent, Prepositions, use of Gerund ,Parallelism, etc (A Representative collection of 100 sentences)

UNIT IV

Technical Communication skills:

Technical Proposal writing- Characteristics, Proposal Superstructure, Checklist , Formal Proposal

Technical Vocabulary- Basic explanations and Description

Technical Report writing- Informational Reports and Feasibility Report- Types, Components, Style and Formats

TEXT BOOKS

[1] Martin Cutts, Oxford guide to Plain English, 7th Impression, Oxford University Press, 2011

[2] M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.

[3] John Langan, College Writing Skills, McGraw Hill, IX Edition, 2014.

[4] Eclectic Learning materials offered by the Department

REFERENCE BOOKS

[1] Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.

[2] Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press,2001

[3] V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://www.britishcouncil.org/english

[2] www.natcorp.ox.ac.uk/Wkshops/Materials/specialising.xml?ID=online

[3] https://www.uni-marburg.de/sprachenzentrum/selbstlernzentrum/.../apps_for_esl.pdf

20BS2151A- ENGINEERING PHYSICS LAB

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Test optical components using principles of interference and diffraction of light
CO2	Use spectrometer, travelling microscope and function generator in various experiments
CO3	Determine the V-I characteristics of photo cells and appreciate the accuracy in measurements

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3								
CO2				3								
CO3	2			3								

COURSE CONTENT

1. Figure of merit of a galvanometer
2. LCR circuit-Study of Resonance
3. Variation of magnetic field along the axis of current-carrying circular coil
4. Wedge Method-Measurement of thickness of a foil
5. Solar cell –Determination of Fill Factor
6. AC Sonometer –Verification of vibrating laws
7. B-H Curve Unit- Determination of hysteresis loss
8. Hall effect –Hall coefficient measurement
9. Diffraction grating-Measurement of wavelength
10. Torsional pendulum-Measurment of Rigidity Modulus
11. Photo cell - Study of V-I Characteristics, determination of work function
12. Optical fiber-Determination of Numerical aperture

TEXT BOOKS

[1] Madhusudhan Rao, “Engineering Physics Lab Manual”, Ist ed., Scitech Publications, 2015
[2] Ramarao Sri, ChoudaryNityanand and Prasad Daruka, ”Lab Manual of Engineering Physics”., Vthed.,
Excell Books, 2010

E-RESOURCES

[1] http://plato.stanford.edu/entries/physics-experiment
[2] http://www.physicsclassroom.com/The-Laboratory
[3] http://facstaff.cbu.edu/~jvarrian/physlabs.html

VIRTUAL LAB REFERENCES

[1] http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1
[2] http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1
[3] http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1

20ES2152B- Python Programming Lab

Course Category:	Engineering Science	**Credits:**	1.5
Course Type:	Lab	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	20ES1103 Programming for Problem Solving 20ES1152 Programming for Problem Solving Laboratory	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Implement python programming constructs to build small to large applications.
CO2	Implement the problems in terms of real-world objects using OOPs concept.
CO3	Evaluate and handle the errors during runtime involved in a program.
CO4	Extract and import packages for developing different solutions for real time problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	3		2						2			3	2	1
CO2	3	2	2						2			3	1	2
CO3	2	2	2						2			3	3	2
CO4	2	2	2						2			3	3	1

COURSE CONTENT

Week 1: Fundamental programs

Running instructions in Interactive interpreter and a Python Script

Write a program to purposefully raise Indentation Error and Correct it

Week 2: Operations

Develop Python programs using basic operations in Python

Week 3 & 4: Conditional &Control Flow

Develop Python programs that makes use of conditional and control flow structures

Week 5: Functions

Develop Python programs using recursive and non-recursive functions

Week 6,7 & 8: Data Structures

Develop Python programs using suitable Data structures

Week 9: Modules

Illustrate installing packages via PIP and develop python programs using modules

Week 10 & 11:

Application oriented Case Studies

Week 12: Classes, Inheritance

Illustrate Class variables and instance variable

Develop Python programs to exemplify the concepts of inheritance and overloading.

TEXT BOOKS

[1]. VamsiKurama, "Python Programming: A Modern Approach", Pearson India, 2017.

[2]. Charles Severance, " Python for Informatics- Exploring Information", 1st edition Shroff Publishers, 2017.

REFERENCE BOOKS

[1]. Mark Lutz,"Learning Python", 5th edition, Orielly, 2013.

[2]. Allen Downey "Think Python, How to Think Like a Computer Scientist",2nd edition, Green Tea Press, 2015.

[3]. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006.

[4]. Kenneth A. Lambert, "Introduction to Python", 1st edition, CengageLearning, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1]. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: https://www.coursera.org/

[2]. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), Available:https://nptel.ac.in/courses/106/106/106106182/#

[3]. Charles Russell Sevarance, University of Michigan, Python for Everybody, 2019 https://www.coursera.org/learn/python

20HS2153- TECHNICAL ENGLISH AND COMMUNICATION SKILLS LABORATORY

Course Category:	Institutional Core	**Credits:**	1.5
Course Type:	Practical	**Lecture -Tutorial-Practice:**	0 - 0 - 3
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Develop active and authentic listening comprehension skills relevant for the professional world.
CO2	Execute web related(On-line) communication with felicity of expression
CO3	Apply relevant speech patterns including standard pronunciation
CO4	Demonstrate Proficiency in Interpersonal Communication with fluency and accuracy

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3				3		
CO2									2	3		
CO3										3		
CO4									2	3		

COURSE CONTENT

UNIT I

Listening Skills:

Exposure to structured and open talks- Active listening, Appreciative listening, Biased listening, Critical listening Empathetic listening, Judgmental listening

Content-oriented Listening Skills :

Short Conversations- 5-10 minute duration- components, statistics, nominal and other references

Concept oriented/ purposive Listening skills:

Long Conversations- 10-30minute duration -

Problems in comprehension & retention – Note-taking practice – Listening tests-

Overcoming Barriers to listening: Physical & psychological – Steps to overcome them with demonstration and practice

Unit-II

Professional and On-line drafting skills:

Professional drafting skills : Circular, Notice, Executive summary
E-mail etiquette- Awareness with Illustrations and practice
Elements of Chat-room interaction- courtesy, techniques of argumentation
Written Response to web-content- conciseness with accountability
Data interpretation- compiling analytical, comparative and critical observations by interpreting graphs, charts, etc.

UNIT III

Phonetics and Speech patterns:

Speech Mechanism – Organs of speech and patterns of articulation of speech sounds.
Vowels, Consonants and Diphthongs- Transcription using International Phonetic Alphabet
Word Stress and Rhythm- practice
Intonation pattern practice- Tones , Tone group boundaries and Tonal variations
Strong forms and weak forms in Connected speech - Illustrations and Practice

UNIT IV

Interpersonal Spoken communication skills:

Fluency & accuracy in speech –Improving self-expression
Listener oriented speaking - Interpersonal Conversation- Manner and Temper
Developing persuasive speaking skills- Role play
Overcoming Barriers to speaking – Building self-confidence– through Conversation practice
Improving responding capacity - Extempore speech practice

TEXT BOOKS

1. Garner, Bryan A, HBR Guide to Better Business Writing, Harvard Business Review Press, Boston, Massachusetts, 2013.
2. Exercises in Spoken English, Prepared by Department of Phonetics and Spoken English, CIEFL,(Currently English and Foreign Languages University) OUP, 21st Impression 2003

REFERENCE BOOKS

[1] Randolph Quirk, Use of English, Longman, I Edition (1968) Reprinted 2004.
[2] Thomson A.J & A.V, Martinet, Practical English Grammar, III Edition, Oxford University Press,2001
[3] V.Sethi and P.V. Dhamija, A Course in Phonetics and Spoken English, II Edition, PHI, 2006

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. ODll Language Learner's Software, Orell Techno Systems
2. Visionet Spears Digital Language Lab software Advance Pro
3. www.natcorp.ox.ac.uk, *British National Corpus*

20ES2154- COMPUTING AND PERIPHERALS LABORATORY

Course Category:	Engineering Sciences	**Credits:**	1
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0 - 0 - 2
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Able to assemble a PC and install operating system and other software.
CO2	Able to trouble shoot hardware and software issues.
CO3	Able to configure network settings to connect to internet.
CO4	Able to create documents, presentations and spread sheets using office productivity tools.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2	3	2							3			
CO3	3			1	2							
CO4	3									2		

COURSE CONTENT

PC Hardware/Software

Week 1 – **Task 1:** Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Week 1– **Task 2:** Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also, students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Week 2 – **Task 1:** Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Week 2 – Task 2: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot with both windows and Linux. Lab

instructors should verify the installation and follow it up with a Viva

Week 3 – **Task 1:** Hardware Troubleshooting: Students have to be given a PC which does not boot due to improper assembly or defective peripherals. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva

Week 3 – **Task 2:** Software Troubleshooting: Students have to be given a malfunctioning CPU due to system software problems. They should identify the problem and fix it to get the computer back to working condition. The work done should be verified by the instructor and followed up with a Viva.

Networks, Internet & World Wide Web

Week 4: Types of Network cables, connectors, crimping straight and crossover cables, identification of network devices (Hubs, Switches, Routers).

Week 5: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally, students should demonstrate, to the instructor, how to access the websites and email.

Week 6: Wifi router configuration, connecting to internet, Static/Dynamic IP address configuration, DNS, Gateway, Security configuration.

Productivity tools

LaTeX and Word

Week 7– Word Orientation: The mentor needs to give an overview of Microsoft (MS) office 2007/ equivalent (FOSS) tool word: Importance of MS office 2007/ equivalent (FOSS) tool Word as word Processors, Details of the three tasks and features that would be covered in word – Accessing, overview of components of toolbars, saving files, Using help and resources, rulers, format painter.

Week 8- Latex: Using LaTeX to create project certificate. Features to be covered: Formatting Fonts, Drop Cap, Applying Text effects, Using Character Spacing, Borders and Colours, Inserting Header and Footer, Using Date and Time option in both LaTeX.

Week 9: Creating project abstract Features to be covered: Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Excel

Week 10 - Task 1 - Excel Orientation: The mentor needs to tell the importance of MS office 2007/ equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the two tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Week 10 – Task2: Calculating GPA -Features to be covered: Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP, Sorting, Conditional formatting

Power Point or equivalent (FOSS) tool

Week 11– Task1: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes: PPT Orientation,

Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in both LaTeX and Power point. Students will be given model power point presentation which needs to be replicated (exactly how it's asked).

Week 12 - Task 3: Concentrating on the in and out of Microsoft power point. Helps them learn best practices in designing and preparing power point presentation. Topics covered during this week includes: - Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide master, notes etc), Inserting – Background, textures, Design Templates, Hidden slides.

TEXT BOOKS

REFERENCE BOOKS

1. LaTeX Companion – Leslie Lamport, PHI/Pearson.
2. Introduction to Computers, Peter Norton, 6/e Mc Graw Hill Publishers.
3. Upgrading and Repairing, PC's 18th e, Scott Muller QUE, Pearson Education
4. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech
5. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.
6. PC Hardware and A+ Handbook – Kate J. Chase PHI (Microsoft)

E-RESOURCES AND OTHER DIGITAL MATERIALL

1. https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17- 1.pdf
2. https://www.protosystech.com/rapid-prototyping.htm
3. https://www.arduino.cc/en/Tutorial/Foundations
4. https://www.tutorialspoint.com/arduino/

20MC2106- PROFESSIONAL ETHICS & PRACTICE

Course Category:	Mandatory Learning	**Credits:**	--
Course Type:	Theory	**Lecture -Tutorial-Practice:**	1 - 0 - 0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	100 -- 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Know the moral autonomy and uses of ethical theories.
CO2	Understand Engineering as Experimentation
CO3	Understand about safety, risk and professional rights.
CO4	Know the ethics regarding Global issues related to Environment, Computers and weapon's development. Understand general principles of contracting.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**											
CO2					**3**							
CO3					**3**							
CO4											**2**	

COURSE CONTENT

UNIT I **(4 lectures)**

Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issues- types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory -Gilligan's theory - consensus and controversy - Models of Professional Roles -theories about right action - Self-interest - customs and religion- uses of ethical theories.

UNIT II **(4 lectures)**

Engineering as Social Experimentation: Engineering as experimentation–engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT III **(4 lectures)**

Safety, Responsibilities and Rights: Safety and risk - assessment of safety and risk - risk benefit

analysis and reducing risk–the three mile island and chernobyl case studies. Collegiality and loyalty–respect for authority-collective bargaining-confidentiality-conflicts of interest- occupational crime-professional rights- employee rights- Intellectual Property Rights (IPR) - discrimination.

UNIT IV **(4 lectures)**

Global Issues: Multinational corporations- Environmental ethics- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-sample code of Ethics (Specific to a particular Engineering Discipline).

General principles of contracts management: Indian contract act,1972 and amendments covering general principles of contracting.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in engineering", McGraw Hill, New York (1996).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, New Delhi(2004).

REFERENCE BOOKS

[1] Baum, R.J. and Flores, A., "Ethical Problems in Engineering, Center for the studyof the Human Dimensions of Science and Technology", Rensellae Polytechnic Institute,Troy, New York, 335 pp. eds. (1978)

[2] Beabout, G.R., Wennemann, D.J. , "Applied Professional Ethics: A Developmental Approach for Use with Case Studies", University Press of America Lanham, MD, 175 pp (1994).

[3] Dutt (1994) Indian Contract Act, Eastern Law House.

SECOND YEAR DETAILED SYLLABUS

SEMESTER– III

S.No	Course Code	Course Category	Course	L	T	P	Credits
1.	20BS3101C	Basic Science	Transformation & Numerical Methods	3	0	0	**3**
2.	20EE3302	Program Core	Electronic Circuits	3	0	0	**3**
3.	20EE3303	Program Core	Electrical Machines-I	3	0	0	**3**
4.	20ES3104	Engineering Science	Network Analysis-II	3	0	0	**3**
5.	20EE3305	Program Core	Digital Electronics	3	0	0	**3**
6.	20ES3151	Engineering Science Lab	Network Analysis Lab	0	0	3	**1.5**
7.	20EE3352	Program Core Lab 1	Electrical Machines –I Lab	0	0	3	**1.5**
8.	20EE3353	Program Core Lab 2	Electronic Circuits Lab	0	0	3	**1.5**
9.	20TP3106	**Soft Skills – 1**	**Logic and Reasoning**	0	0	2	**1**
10.	20MC3107B	Mandatory Course	Indian Constitution (EIE/CE/ME/EEE)	2	0	0	**-**
			TOTAL	17	0	11	20.5

20BS3101C-TRANSFORMATIONS & NUMERICAL METHODS

Course Category:	**Basic Science Course**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Matrices and Differential Calculus (20BS1101) Laplace transforms and integral calculus (20BS2101)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** general periodic functions in the form of an infinite convergence series of sines and cosines.
CO2	**Apply** Fourier transforms to evaluate indefinite integrals and engineering problems.
CO3	**Find solutions for** algebraic, transcendental, system of equations and estimate functions using polynomial interpolation.
CO4	**Solve initial value problems** numerically.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, H - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			1								1	2
CO2	3	2			1								1	2
CO3	3	2			1								1	2
CO4	3	2			1								1	2

Course Content

UNIT-I **[Text Book-1]**

Fourier Series: Introduction, Euler's formulae, conditions for a Fourier expansion, functions having points of discontinuity, change of interval, odd and even functions, expansions of odd and even periodic functions, half-range series, Parseval's formula, complex form of Fourier series.

UNIT-II **[Text Book-1]**

Fourier Transforms: Introduction, definition, Fourier integrals, Fourier sine and cosine integrals-complex form of Fourier integrals, Fourier transforms, Fourier sine and cosine transforms-Finite Fourier sine and cosine transforms.

UNIT-III **[Text Book-1]**

Numerical Methods: Solution of algebraic and transcendental equations-introduction, Newton-Raphson method, solution of simultaneous linear equations-Gauss-Seidel iterative method.

Interpolation: Introduction, finite differences, forward, backward, central differences, symbolic relations, differences of a polynomial, Newton's formulae for interpolation, Interpolation with unequal intervals,-Lagrange's and Newton's interpolation formulae.

UNIT-IV **[Text Book-1]**

Numerical Differentiation and Integration: Finding first and second order differentials using Newton's formulae, Trapezoidal rule, Simpsons 1/3 rule.
Numerical Solutions of Differential Equations: Taylor's series method, Euler's method, Euler's modified, Runge-Kutta method of 4^{th} order.

Text Book:

[1] B.S.Grewal, "*Higher Engineering Mathematics*", Khanna Publishers, 43^{rd} edition, 2014.

Reference Books:

[1] Krezig, "*Advanced Engineering Mathematics*", John Wiley & sons, 8^{th} edition, 2007.
[2] K.Das, Er. Rajnish Verma, "*Higher Engineering Mathematics*" S.Chand, 1^{st} edition, 2011.
[3] R.K.Jain &S.R.K.Iyengar, "*Advanced Engineering Mathematics*", 3^{rd} edition, Narosa Publishers.
[4] N.P.Bali, Manish Goyal, "*A Text book of Engineering Mathematics*", Lakshmi Publications (P) Limited, 1^{st} edition, 2011.
[5] S.S.Sastry, "*Introductory Methods of Numerical Analysis*", Prentice Hall of India, 2005.

E-resources and other digital material

[1] Prof.Ameeya Kumar Nayak,Sanjeev Kumar, IIT Roorkee, Numerical methods, Available:https://onlinecourses.nptel.ac.in/noc21 ma45/preview
[2] Henrik Schmidt, Massachusetts Institute of Technology: MIT Open Courseware, *Introduction to Numerical Analysis for Engineering.*
Available:https://ocw.mit.edu
[3] Prof. Adrijit Goswami, IIT Kharagpur, Transform Calculus and its applications in Differential Equations.
Available: https://nptel.ac.in/courses/111/105/111105123/

20EE3302-ELECTRONIC CIRCUITS

Course Category:	**Program Core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Network Analysis-I (20ES2104E)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** and design basic diode circuits related to various applications.
CO2	**Analyze** and design different transistor circuits, stabilization and compensation circuits.
CO3	**Analyze** the behavior of BJT and FET at low frequencies.
CO4	**Analyze** the behavior of BJT and FET at high frequencies.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	2	3	2										2
CO2	**3**	2	3	2										2
CO3	**3**	2	3	2										2
CO4	**3**	2	3	2										2

Course Content

UNIT-I **[Text Book-1& 2]**

Semiconductor-Diode and its Applications: Overview of P-N junction diode, diode approximations, diode as a rectifier, half wave, full wave (center-tapped) and bridge rectifiers without filter, with L & C filters, L-section and π-section filters, multiple L-section, multiple π-section filters, clippers and clampers.

Special-Purpose Diodes: Light emitting diodes, laser diodes, photodiodes, solar cells, varactor diode, PIN diode, tunnel diode, Zener diodes, Zener diode as voltage regulator.

UNIT-II **[Text Book-1]**

Transistor & FET: Introduction**,** over view of Common Base, Common Emitter, Common Collector configurations, operating point, biasing circuits- fixed bias, collector to base bias, self-bias, stability factors, bias compensation circuits, diode compensation for V_{BE} and $I_{CO,}$ thermistor and sensistor compensation, thermal runaway and thermal stability.

FET: Classification, JFET construction, operation, common source, common drain and common gate configurations, MOSFET construction and operation.

UNIT-III **[Text Book-1]**

Transistor Amplifiers at Low Frequencies:

BJT Amplifiers: Hybrid parameter model of transistor, measurement of h-parameters, analysis of transistor amplifier using h- parameter exact and approximate model of CE, CB and CC.

FET Amplifiers*:* FET Amplifiers at low frequencies, CS/CD/CG configurations at low frequencies.

UNIT-IV **[Text Book-1]**

Transistor Amplifiers at High Frequencies:

BJT Amplifiers: BJT at high frequencies, hybrid π-model, CE short circuit current gain without load, CE short circuit current gain with resistive load, single stage CE transistor amplifier response, emitter follower at high frequencies, gain bandwidth product.

FET Amplifiers: FET amplifier at high frequencies -CS/CD amplifiers.

Text Books:

[1] Jacob Millman, Christos C Halkias & Satyabrata JIT, "*Electronic Devices and Circuits*", 3rd edition, Tata McGraw Hill Ltd, 2007.

[2] Robert L Boylested and Louis Nashelsky, "*Electronic Devices and Circuit Theory*", PHI, 8th edition, 2003.

Reference Books:

[1] David A Bell, "*Electronic Devices and Circuits*", Oxford University press, 5th Edition, 2008

[2] Jacob Millman and Christos C Halkias, *"Integrated Electronics: Analog and Digital Circuits and Systems"*, Tata McGraw Hill Ltd, 2003.

[3] G .K. Mithal *"Electronic Devices and Circuits"* Khanna Publishers, 1997

[4] S Salivahana *"Electronic Devices and Circuits"* Tata McGraw Hill Ltd, 2nd edition, 2011

[5] David A Bell *"Electronic Devices and Circuits"* Printice Hall of India, 4th edition, 2003

E-resources and other digital material

[1] Tony R. Kuphaldt, "*Electric Circuits, Volume III-Semiconductors*", 5th edition, 2009 (e-book).

[2] http://nptel.iitm.ac.in/courses.php?branch=Ece

[3] www.ibiblio.org/obp/electricCircuits

20EE3303-ELECTRICAL MACHINES-I

Course Category:	**Program Core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Network Analysis-I (20ES2104E)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** the concepts of electro-mechanical energy conversion, construction, operation and performance of DC generators.
CO2	**Analyze** the operation and performance of DC motors.
CO3	**Analyze** and **Evaluate** the performance of single phase transformers.
CO4	**Analyze** and **Evaluate** the performance of three phase transformers

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**	**2**	**3**			**2**						**3**	**3**
CO2	**3**	**3**	**2**	**3**			**3**						**1**	**2**
CO3	**2**	**3**	**2**	**3**			**2**						**2**	**2**
CO4	**3**	**1**	**2**	**3**			**3**						**2**	**3**

Course Content

UNIT- I **[Text Book-1 & 2]**

Electromechanical Energy Conversion: Energy in magnetic systems, field energy and mechanical force, singly and doubly excited magnetic field systems, forces and torques in systems with electromagnets.

DC Generators: Construction, principle of operation, EMF equation, armature reaction, compensating windings, commutation, methods of excitation, operating characteristics of DC generators, applications of DC generator.

UNIT-II **[Text Book-1 & 2]**

DC Motors: Principle of operation, significance of back EMF, torque equation, characteristics of DC motors, starting methods, speed control methods, losses and efficiency. Testing of DC machines-Brake test, Swinburne's test, Hopkinson test, field test, applications of DC motors.

UNIT-III **[Text Book- 1]**

Single Phase Transformer: Transformer construction, principle of operation, EMF equation, ideal transformer, practical transformer, phasor diagram, equivalent circuit, transformer losses, regulation and efficiency, all day efficiency, auto transformer, Transformer testing-polarity test, open circuit and short circuit tests, Sumpner's test, parallel operation of single phase transformer, applications of transformers.

UNIT-IV **[Text Book-1]**

Three-Phase Transformer: Three phase transformer construction, three phase transformer

connections, phase groups, parallel operation of three phase transformers, three winding transformers (Tertiary winding), open delta connection, Scott connection, tap changing of transformers.

Text Books:

[1] I.J.Nagrath and D.P. Kothari, "*Electric Machines*", Tata McGraw-Hill Education Private Limited Publishing Company Ltd, New Delhi, 4th edition, 2010.

[2] Ashfaq Husain, " Electrical Machines", Dhanpat Rai & Co. (Pvt) Ltd, 2nd edition, 2009.

Reference Books:

[1] P. S. Bhimbra, "*Electrical Machinery*", Khanna Publications, 7thedition, 2007.

[2] A.E. Clayton, "*The Performance & design of DC Machines*", CBS publisher & distributors, Delhi, 1st edition, 2003.

[3] A.E Fitzgerald and Charles Kinsley, "*Electric Machinery*", Tata McGraw-Hill Education Private Ltd, New Delhi, 6th edition, 2002.

[4] J.B. Gupta, "*Theory & Performance of Electrical Machines*", S.K.Kataria & Sons, New Delhi,15th edition, 2015

[5] B.L.Theraja and A.K.Theraja, "*Electric Technology*", S Chand & Co. (Pvt.) Ltd, New Delhi, Volume-II, 2012.

E-resources and other digital material

[1] http://nptel.ac.in/courses/108105017/

20ES3104-NETWORK ANALYSIS-II

Course Category:	**Engineering Science Course**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Matrices and Differential Calculus (20BS1101) Network Analysis-I (20ES2104E)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks::**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** transient response of electric circuits.
CO2	**Determine** network functions and two-port parameters.
CO3	**Apply** Fourier analysis to analyze electric circuits and design the filters.
CO4	**Synthesize** single port networks.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2	2						3		3	
CO2	3	3	1	2							3		2	
CO3	3	3			1						3		2	
CO4	3	3	3								3		1	

Course Content

UNIT-I **[Text Book-1&2]**

Transients: Introduction-initial conditions, direct current transients- RL, RC, RLC circuits, two mesh transients. Alternating current transients - RL, RC, and RLC circuits, two mesh transients (Both differential equation and Laplace transform approaches), response of RL, RC and RLC circuits to periodic functions-impulse, step, ramp and exponential using Laplace transforms.

UNIT-II **[Text Book-1]**

Network Function: Introduction, driving point functions, transfer functions, analysis of ladder and non-ladder networks, Poles and Zeros of network functions, restrictions on poles and zeros for driving- point and transfer functions, time domain behavior from pole zero plot, graphical method for determination of residue.

Two Port Networks: Introduction, open circuit impedance parameters, short circuit admittance parameters, transmission (ABCD) parameters, inverse transmission parameters, hybrid parameters, inverse hybrid parameters, condition of symmetry and reciprocity in two port parameter representation, inter-relation between parameters of two port networks, inter connection of two-port networks-cascade, series and parallel.

UNIT-III **[Text Book-1]**

Fourier Series Analysis: Introduction, trigonometric form of the Fourier series, wave form

symmetry, exponential form of the Fourier series, average value and RMS value of a periodic complex wave, power supplied by complex wave.

Filters: Introduction, classification and characteristics of filters-low pass, high pass, band pass and band stop filters, analysis and design of filter networks of both T and π configurations (**constant k type** filters only).

UNIT-IV **[Text Book-1]**

Network Synthesis: Introduction, Hurwitz polynomials and properties, positive real functions and its properties, elementary synthesis concepts, realization of LC, RC and RL functions of single port networks using Foster form and Cauer form.

Text Books:

[1] Ravish R Singh, "*Network Analysis and Synthesis*", McGraw-Hill Education (India) Pvt. Ltd., Chennai, 1st edition, 2018.

[2] A. Chakrabarthi, "*Circuit Theory (Analysis and Synthesis)*", Dhanpat Rai & Co. Pvt. Ltd., 6th edition, 2013.

Reference books:

[1] M.E.VanValkenburg, "*Network Analysis*", Prentice Hall of India Pvt. Ltd, New Delhi, 3rdedition, 2006.

[2] William H.Hayt, Jack.E.Kemmerly & Steven.M Durbin, "*Engineering Circuit Analysis*", Tata McGraw-Hill, New Delhi, 8th edition, 2012 .

[3] Charles K.Alexander & Matthew N. O. Sadiku, "*Fundamentals of Electric Circuits*", McGraw-Hill, 5th edition, 2012.

[4] A.Sudhakar & P.Shyam Mohan, "*Circuits and Networks Analysis and Synthesis*", Tata McGraw-Hill, New Delhi, 3rd edition, 2007

E-resources and other digital material

[1] http://nptel.ac.in/courses/108102042/

20EE3305-DIGITAL ELECTRONICS

Course Category:	**Program Core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Engineering Physics (20BS2102A)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Construct** the binary codes and **Elucidate** various logic families.
CO2	**Design** and **Implement** combinational logic circuits.
CO3	**Elucidate** flip-flops, registers and counters.
CO4	**Design** and **Implement** sequential logic circuits and programmable logic devices.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3										2
CO2	2	3	3	3										2
CO3	2	3	3	3		1								2
CO4	2	2	3	3		3								2

Course Content

UNIT-I **[Text Book-1&2]**

Number Systems: Number systems and codes, error detection and correction codes**.**

Digital Logic Families: Characteristics of digital logic families, Introduction to RTL, DTL, TTL, ECL and MOS logic families, comparison of different logic families**.**

UNIT-II **[Text Book-1&2]**

Minimization of Switching Functions: SOP and POS forms, K-map representations, minimization using K-maps, simplification**,** don't care conditions**,** Quine-Mccluskey method.

Combinational Logic Design: Adders, subtractors, multiplexers and de-multiplexers, decoders and encoders, code converters.

UNIT-III **[Text Book-1 &2]**

Sequential Logic Circuits: One-bit memory cell, SR, JK, D and T flip-flops, level triggering and edge triggering, conversion of flip-flops**.**

Registers and Counters: Shift registers, asynchronous and synchronous type, modulo and ring counters.

UNIT-IV **[Text Book-1&2]**

Synchronous Sequential Logic Circuits: Moore and Mealy models, state diagrams, state assignment, state table and excitation tables, state reduction, design of counters**.**

Programmable Logic Devices: Read Only Memory, ROM organization, design of combinational circuit using ROM, Programmable Logic Array (PLA), PLA Programming table and Programmable Array Logic (PAL).

Text Books:

[1] R P Jain, "*Modern Digital Electronics*", Tata Mc. Graw Hill Publication, New Delhi, 4th edition, 2010

[2] M. Morris Mano, "*Digital Logic and Computer Design*", Pearson India Education Services Ltd., 2016.

Reference Books:

[1] Taub & Schilling, "*Digital integrated Electronics"*, Mc Graw-Hill, Delhi, 1986.

[2] Anand Kumar, "*Fundamentals of Digital Circuits*" Prentice Hall of India, 2nd edition, 2009.

[3] Gordon J Deboo & Clifford N. Burrous, "*Integrated Circuits and Semiconductor Devices*", International Student Edition, Tata McGraw-Hill, 2nd edition.

E-resources and other digital material

[1] http://www.nptel.ac.in/courses/117106086/

[2] http://www.docstoc.com/docs/14901337/Fundamentals-of-Digital-Electronics

[3] http://www.ebookee.com/Fundamentals-of-Digital-Electronics_313329.

20ES3151-NETWORK ANALYSIS LABORATORY

Course Category:	**Engineering Science Course**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Network Analysis-I (20ES2104E)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze** and present experimental results.
CO3	**Exhibit** professional behavior.

Contribution of Course Outcomes towards achievement of Program Outcomes (1- Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3	1	1						3			3
CO2			3							3	3			
CO3			3							3				

Course Content

1. Verification of KCL & KVL for DC and AC circuits (hardware and simulation).
2. Verification of Thevenin's & Maximum power transfer theorems.
3. Verification of superposition & reciprocity theorems.
4. Estimation of self & mutual inductance of coupled circuits.
5. Determination of Z &Y parameters of a given two port network.
6. Realization of series and parallel resonance.
7. Measurement of active and reactive power by two wattmeter method in balanced and unbalanced three phase circuits.
8. Mesh and Nodal analysis using simulation tool.
9. Simulation of DC transients.
10. Simulation of Thevenin's and Norton's theorems.
11. Simulation of Reciprocity and Millman's theorems.
12. Harmonic analysis of non-sinusoidal waveform signals using harmonic analyzer and plotting frequency spectrum.

NOTE**:** **A** minimum of **ten** experiments are to be completed.

20EE3352- ELECTRICAL MACHINES-I LABORATORY

Course Category:	**Program Core Lab**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Electrical Machines-I (20EE3303)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze** and present experimental results.
CO3	**Exhibit** professional behavior

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2	3	1				3				3	2
CO2	2			2	3				3				2	3
CO3	1		2	2	3								1	1

Course Content

PART-A: DC Machines:

1. No load & load characteristics of separately excited DC generator.
2. Speed control of DC shunt motor.
3. Brake test on DC shunt motor.
4. Load test on DC series Motor.
5. Swinburne's Test on DC shunt motor.
6. Hopkinson's test on DC motor-generator set.
7. Simulation of speed control of DC shunt motor.
8. Simulation of DC compound motor characteristics.
9. Simulation of separately excited DC generator.
10. Simulation of load characteristic of DC separately excited generator.

PART-B: Transformers:

1. Open circuit and short circuit tests on single phase transformer.
2. Sumpner's test on single phase transformers.
3. Parallel operation of single phase transformers.
4. Load test on three phase transformer.

5. Scott connection of three phase transformers.
6. Simulation of open circuit and short circuit tests on single phase transformer.
7. Simulation of Load test on three phase transformer.
8. Simulation of single phase transformer equivalent circuit.
9. Simulation of three phase transformer banks.
10. Simulation of polarity & Turns Ratio Test of single phase transformer.

Note:

1. A minimum of 10 experiments are to be completed.
   (Minimum of 2 simulation experiments are to be performed from each Part)
2. Five experiments from Part-A & Five experiments from Part B
3. Students are encouraged to do experiments with virtual labs.

20EE3353- ELECTRONIC CIRCUITS LABORATORY

Course Category:	**Program Core**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Electronics circuits (20EE3302)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze** and present experimental results.
CO3	**Exhibit** professional behavior.

Contribution of Course Outcomes towards achievement of Program Outcomes (1- Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		3	2									2
CO2	3			3			1							2
CO3				3				1						2

Course Content

LIST OF EXPERIMENTS

1. Electronic components testing (Diode, Transistors, LED, Photo- Diode, Capacitor nomenclature, ICs, color coding of resistors) and CRO Basics.
2. Demo of making PCB using screen printing.
3. PCB Design –I (Schematic).
4. PCB Design –II (Rooting).
5. PCB Design –III (Etching Process).

PART-A: Electronics Devices Lab

1. Characteristics of PN junction diode.
2. Characteristics of Zener diode.
3. Characteristics of LED and photo diode.
4. Analysis of half wave rectifiers with and without filter.
5. Analysis of full wave rectifiers with and without filter.
6. Characteristics of transistor in Common Base configuration.
7. Characteristics of transistor in Common Emitter configuration.
8. Verification of transistor self-bias circuit.
9. Characteristics of Junction Field Effect Transistor.

10. Characteristics of uni-junction transistor.

PART – B: Digital Electronics Lab

1. Realization of logic gates using discrete components and universal gates.
2. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
3. Design of binary to gray and gray to binary converters.
4. Verification of flip-flops using logic gates.
5. Implementation of 4-bit parallel Adder/ Subtractor using IC 7483.
6. Design of BCD to 7-segment display driver.
7. Design and Verification of Shift registers.
8. Design of modulo – N counter.
9. Design of 1-bit Arithmetic Logic Unit (ALU).
10. Design and verification of synchronous and asynchronous counters using flip flops and IC 74163.

NOTE**:**

1. A minimum of **ten** experiments are to be completed.
2. **Minimum Five** from **PART-A** and **PART-B** are to be completed.

20TP3106-LOGIC & REASONING

Course Category:	**Soft Skills**	**Credits:**	1
Course Type:	Learning by doing	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:		**Continuous Evaluation:**	100M
		Semester End Evaluation:	0M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Think** reason logically in any critical situation.
CO2	**Analyze** given information to find correct solution.
CO3	**Reduce** the mistakes in day to day activities in practical life.
CO4	**Develop** time-management skills by approaching different shortcut methods.
CO5	**Use** mathematical based reasoning to make decisions.
CO6	**Apply** logical thinking to solve problems and puzzles in qualifying exams in any competitive exam.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								2						
CO2				2										
CO3								2						
CO4											2			
CO5									2					
CO6								2						

Course Content

UNIT-I **[Text Book-1]**

1. Series completion
2. Coding-Decoding
3. Blood relation
4. Puzzles test

UNIT-II **[Text Book-1]**

1. Direction sense test
2. Logical Venn diagrams
3. Number test, ranking test
4. Mathematical operations

UNIT-III **[Text Book-1]**

1. Arithmetical reasoning

2. Inserting missing character
3. Syllogism.

UNIT-IV **[Text Book-1]**

Non-Verbal:

1. Water images
2. Mirror images
3. Paper folding
4. Paper cutting
5. Embedded figures
6. Dot situation
7. Cubes & Dice

Text Book:

[1] R. S. Aggarwal, "*Verbal and non-verbal reasoning*", S Chand publication, revised edition, 2017. ISBN:81-219-0551.

20MC3107B- THE CONSTITUTION OF INDIA -1950

Course Category:	Mandatory Course	Credits:	-
Course Type:	Theory	Lecture-Tutorial-Practice:	2-0-0
Prerequisites:		Continuous Evaluation:	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the spirit and origin of the fundamental law of the land.
CO2	**Understand** how fundamental rights can be protected.
CO3	**Understand** the structure and formation of the Indian Government at center as well as state.
CO4	**Understand** when and how an emergency can be imposed and its consequences.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1- Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2								
CO2						2								
CO3						2								
CO4						2								

Course Content

UNIT-I **[Text Book-2]**

Introduction to Constitution of India: Meaning of the constitution law and constitutionalism, historical perspective of the constitution of India, salient features and characteristics of the constitution of India.

UNIT-II **[Text Book-1 & 2]**

Fundamental Rights: Scheme of the fundamental rights, scheme of the fundamental right to equality, scheme of the fundamental right to certain freedoms under article 19,scope of the right to life and personal liberty under article 21.

UNIT-III **[Text Book-1]**

Nature of the Indian Constitution: Federal structure and distribution of legislative and financial powers between the union and the states.

Parliamentary Form of Government in India: The constitution powers and status of the President of India, amendment of the constitutional powers and procedure, the historical perspectives of the constitutional amendments in India.

Local Self-Government: Constitutional scheme in India.

UNIT-IV **[Text Book-1 & 2]**

Emergency Provisions: National emergency, president rule, financial emergency.

Text Book:

[1] Dr. J.C. Johari, "*India Government and politics*", Vishal Publications, New Delhi,2009

[2] M. V. Pylee, "*Introduction to constitution of India*", Vishal Publications, New Delhi , 5th edition, 2009

Reference Books:

[1] D.D. Basu, "*Introduction to the Constitution of India*", Lexis Nexis, 2015.

[2] Subhas C.Kashyap, "*Our Constitution*", National Book Trust India, 2nd edition, New Delhi, 2013

SEMESTER IV

CONTACT HOURS: 31

S.No	Course Code	Course Category	Course	L	T	P	Credits
1.	20BS4101	Basic Science	Electrical Measurements and Sensors	3	0	0	3
2.	20EE4302	Program Core	Linear Control Systems	3	0	0	3
3.	20EE4303	Program Core	Electrical Machines-II	3	0	0	3
4.	20EE4304	Program Core	Linear Integrated Circuits and Applications	3	0	0	3
5.	20HS4105	Humanities and Social Sciences	Universal Human Values	3	0	0	3
6.	20EE4351	Program Core Lab1	Electrical Machines-II Lab	0	0	3	1.5
7.	20EE4352	Program Core Lab 2	Measurements and Control Systems Lab	0	0	3	1.5
8.	20EE4353	Program Core Lab 3	Linear Integrated CircuitsLab	0	0	3	1.5
9.	20TP4106	Soft Skills – 2	English for Professionals	0	0	2	1
10.	**20EE4654**	**Skill Oriented Course -1**	**Design Thinking**	**1**	**0**	**2**	**2**
11.	20MC4108A	Mandatory Course	Environmental Studies	2	0	0	-
			TOTAL	**18**	**0**	**13**	**22.5**

Summer Internship 6 weeks (Mandatory) during summer vacation (EPICS)				
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)	**4**	**0**	**0**	**4**

Category	**Credits**
Basic Science Courses	3
Program Core Courses	13.5
Engineering Science Courses	0
Skill Oriented courses	3
Humanities and Social Science courses	3
Mandatory Courses	0
TOTAL CREDITS	**22.5**

20BS4101-ELECTRICAL MEASUREMENTS AND SENSORS

Course Category:	Basic Science Course	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	Engineering Physics (20BS2102A) Network Analysis-I (20ES2104E) Digital Electronics (20EE3305)	Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Elucidate** the basic laws governing the operation of electrical measuring instruments and measure electrical quantities like voltage, current and power.
CO2	**Explain** the time and frequency measurement techniques for digital meters.
CO3	**Apply** principles of CT and PT for measurement of electrical quantities.
CO4	**Apply** the concepts of signal conditioning circuit for various transducers and understand the concept of Digital Storage oscilloscopes.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1									2	
CO2	3	3		3								1	2	
CO3	3	3	2	3										2
CO4	3	3	2	2								1	2	

Course Content

UNIT-I **[Text Book-1]**

Analog Instruments: Classification of analog Instruments, principles of operation, electro-mechanical indicating instruments – operating forces, control systems, damping systems.

Analog Ammeters, Voltmeters and Wattmeter: Permanent magnet moving coil instruments, moving iron instruments, electrodynamometer wattmeter (construction, general torque equation, shape of scale, advantages, disadvantages and errors).

UNIT-II **[Text Book-2]**

Philosophy of digital measurements, software controlled measurements

Digital Time and Frequency Measurement Techniques: Measurement of time interval between two events, error in time interval measurement, resolution, measurement of periodic time, measurement of frequency, ratio of two frequencies-product of two frequencies, high frequency, average frequency difference, power system frequency deviation measurement.

Digital Meters:

Capacitance measurement using exponential discharging, phase measurement, requirements of an ideal phase meter, phase measurement through time measurement, measurement of periodic time and phase, dual slope voltage to time conversion.

UNIT-III **[Text Book-1 & 2]**

Instrument Transformers: Current Transformers-Theory, Ratio error and phase angle errors, effect of Secondary open circuit, **Potential Transformers**-Theory, Ratio error and phase angle errors,
AC power measurement, energy measurement, voltage measurement, current measurement.

UNIT-IV

Special Sensors: **[Text Book-3]**

Introduction, Smart sensors, Micro sensors, IR radiation sensors, Ultrasonic sensors, Fiber optic sensors, and Bio sensors

Digital Storage Oscilloscopes: **[Text Book-1]**

Principle of operation, Wave form recognition, Comparison between analog and Digital storage oscilloscopes, Accessories of Cathode Ray oscilloscope: Calibrators, Probes, Cameras, Electronic switch

Text Books:

[1] A.K.Sawhney, "*A course in Electrical & Electronic Measurements and Instrumentation*", DhanapthRai& Co., New Delhi, 19th edition, 2013.

[2] T.S.Rathore, *Digital measurement Techniques*, Narosa Publishing house, 1996.

[3] D.V.S.Murty, "Transducers & Instrumentation", Prentice Hall of India,2nd edition, 2013

Reference Books:

[1] H.S.Kalsi, "*Electronic Instrumentation",* Mc. Graw Hill Education, New Delhi, 3rd edition, 2018.

[2] J.B.Gupta, "*A course in Electronic & Electrical Measurements and Instrumentation*", S. K. Kataria& Sons, New Delhi, 2009.

[3] E.W.Golding and F.C.Widdis, "*Electrical Measurements and measuring instruments"*, Wheeler Publishers, New Delhi, 5thedition, 2009.

E-resources and other digital material

[1] http://nptel.ac.in/syllabus/108106070/

20EE4302-LINEAR CONTROL SYSTEMS

Course Category:	Program Core	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	Network Analysis-I (20ES2104E)	Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Determine** transfer function models of electrical, and mechanical systems
CO2	**Analyze** the behavior of the system under time domain approach and graphical method.
CO3	**Apply** graphical methods to analyze the behavior of the system under frequency domain approach.
CO4	**Analyze** state space models of various systems

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3	1								1	2	2
CO2	3		3	1								1	2	2
CO3	3		3	1								1	2	2
CO4	3		3	1								1	2	2

Course Content

UNIT-I **[Text Book-1]**

Introduction: Control system terminology, open loop and closed loop control systems, effect of feedback on overall gain, stability, sensitivity, external noise, types of feedback control systems – linear, nonlinear, time invariant and time varying systems.

Mathematical Models of Physical Systems: Modeling of mechanical and electrical systems, analogous systems, transfer functions of mechanical, electrical and electro-mechanical systems, characteristic equation of feedback systems, poles and zeros, block diagram- definition, reduction rules, signal flow graph- definition, Mason's gain formula.

UNIT-II **[Text Book-1]**

Time Response Analysis: Standard test signals-step, ramp, parabolic and impulse, time response of first-order system to standard test signals, second order systems- unit step response of second order under damped system, time domain specifications, steady state errors and static error constants.

Stability Analysis in Complex Plane: stability definitions, stability study based on location of poles, Routh–Hurwitz criterion, root locus technique- definition, construction rules and problems. (**For positive values of K only**).

Basic Controllers: P, I, PI, PD and PID control actions.

UNIT-III **[Text Book-1]**

Frequency Domain Analysis: Introduction, frequency domain specifications, correlation between time and frequency responses, bode plots, polar plots, phase margin and gain margin,principle of argument, Nyquist stability criterion.

UNIT-IV **[Text Book-1&2]**

State Space Analysis: Concepts of state, state variables, state model, state space representation using physical variables with basic electrical and mechanical systems, solution of state equations, computation of state transition matrix- infinite series method, Laplace transform method, transfer function from state model, eigen values and stability analysis, controllability and observability of linear systems.

Text Books:

[1] A. Anand Kumar, "*Control Systems*", Prentice Hall of India Private Ltd, Delhi, 2nd edition, 2014.
[2] I.J. Nagrath & M.Gopal, "*Control Systems Engineering*", New Age International (P) publishers, 5th edition, 2009.

Reference Books:

[1] K. Ogata, "*Modern Control Engineering*", Prentice Hall of India publishers, 5th edition, 2010.
[2] B.C. Kuo, "*Automatic Control Systems with MATLAB programming*", Prentice Hall of India publishers, 7th edition, 2015.
[3] Schaum's Series, "*Feedback and control systems*", Tata McGraw Hill (Pvt.) Ltd., 2nd edition.

E-resources and other digital material

[1]www.nptel.ac.in/courses/108101037/
[2] www.dis.uniroma1.it/~lanai/controlsystems/cs_lectures_enhtml

20EE4303-ELECTRICAL MACHINES-II

Course Category:	Program Core	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	Electrical Machines-I (20EE3303)	Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the constructional details and principle of operation of synchronous generators.
CO2	**Analyze** the performance of the synchronous motor and its applications.
CO3	**Understand** the constructional details and principle of operation of three phase AC induction motor and speed control methods.
CO4	**Analyze** the starting methods of single phase AC induction motor and performance of special electrical machines.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3			3						3	3
CO2	3	3	2	3			3						2	2
CO3	3	3	2	3			3						3	3
CO4	3	3	2	2			3						2	2

Course Content

UNIT–I **[Text Book-2]**

Synchronous Generators: Construction, types of rotors, working principle, winding factors, EMF equation, armature reaction, phasor diagram of non-salient pole synchronous generator under no-load and loaded conditions, voltage regulation, direct load, EMF, MMF, and ZPF methods,synchronization of alternator with infinite bus, parallel operation, effect of variation of excitation and mechanical input, efficiency of the synchronous generator, two reaction theory of salient pole machine, phasor diagram.

UNIT–II **[Text Book-2]**

Synchronous Motor: Principle of operation, starting methods, torque equation, phasor diagram, different torques, effects of varying excitation, minimum and maximum power for a given excitation, Vand inverted V curves, measurement of X_d and X_q, slip test, efficiency, application of synchronous motors as condenser

UNIT–III **[Text Book-1]**

Three Phase Induction Motors: Construction, rotating magnetic field, operation of squirrel cage and slip ring motors, torque equation, torque-slip characteristics, equivalent circuit, losses and efficiency, testing and circle diagram, starting methods, speed control, stator voltage control, v/f control, induction generator.

UNIT-IV **[Text Book-1]**

Single Phase Induction Motors: Construction, double field revolving theory, equivalent

circuit, no-load and blocked rotor tests, starting methods, split phase, capacitor start and run motor.

Special Machines: Principle of operation and characteristics - Permanent Magnet Synchronous Motor, BLDC motor, stepper motors.

Text Books:

[1] I. J. Nagrath and D.P. Kothari, "*Electric Machines*", Tata McGraw Hill Education Private Limited,4th edition, 2010.

[2] Ashfaq Husain, "*Electric Machines*", Dhanpat Rai& Co. (Pvt.) Ltd, 2nd edition, 2009.

Reference Books:

[1] Dr. P. S. Bhimbra, "*Electrical Machinery*", Khanna Publications, 7thedition, 2007.

[2] A.E Fitzgerald and Charles Kinsley, "*Electric Machinery*", TMH s Publications, 6thedition, 2002.

[3] Alexander S. Langsdorf, "*Theory of Alternating- Current Machinery"* Tata McGraw-Hill Publications, 2001.

[4] J.B Gupta, "*Theory & Performance of Electrical Machines*", S.K.Kataria & Sons, 15th edition, 2015.

E-resources and other digital material

[1] http://nptel.ac.in/courses/108105017/

20EE4304–LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

Course Category:	Program Core	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	Electronic Circuits-(20EE3302) Network Theory-I & II (20ES2104, 20ES3104)	Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the concepts of op-amps and its applications.
CO2	**Explain** different non-linear op-amp circuits and waveform generators.
CO3	**Analyze** active filters, ADCs and DACs.
CO4	**Analyze** timer circuits, PLL and voltage regulators.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**			**2**					**3**					**2**
CO2	**3**			**3**					**3**					**2**
CO3	**3**			**2**					**3**					**2**
CO4	**3**			**2**										**2**

Course Content

UNIT-I **[Text Book-1&2]**

Operational Amplifiers: Integrated circuits-types, classification, package types and power supply connections, operational-amplifier block diagram, ideal and practical operational-amplifier, Operational-amplifier characteristics-DC and AC characteristics. frequency response and slew rate

Linear Applications of Operational Amplifiers: Negative feedback concept in operational-amplifiers, inverting and non-inverting amplifier, voltage follower, differential amplifier, summing amplifier, instrumentation amplifier, integrator and differentiator.

UNIT-II **[Text Book-1&2]**

Non-Linear Applications of Operational Amplifiers: Sample and hold circuit, precision diode, Precision full wave rectifier, peak value detector, clipper and clamper circuit.

Comparators and Waveform Generators: Introduction to comparator, basic comparator, applications-zero-crossing detector, window detector, waveform generators- Schmitt trigger, square-wave generator, triangular wave generator.

UNIT-III **[Text Book–1&2]**

Active Filters: Active low pass and high pass filters, wide band pass filter, band stop filters, notch filter and all pass filters.

D/A and A/D Converters: Introduction, basic digital to analog converter techniques-weighted resistor digital to analog converter, R-2R ladder D/A converter; A/D conversion–parallel comparator type analog to digital converter, successive approximation analog to digital converter and

dual slope analog to digital converter

UNIT-IV **[Text Book-1&2]**

Applications of Special ICS: 555 Timer-As mono-stable and astable multi-vibrators, voltage controlled oscillator(IC566); phase locked loops- operating principles, monolithic PLLs, IC voltage regulators-Fixed voltage regulators- LM78XX, LM79XX; Variable voltage regulators – LM317, LM723IC

Text books:

[1] Rama Kant A. Gayakwad, "*Operational amplifiers and Linear Integrated Circuits*", Prentice Hall India Pvt. Ltd.,4th Edition ,2012

[2] Roy Choudhry and Shail B. Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd, 4th Edition,2011.

Reference Books:

[1] Jacob, "*Applications and Design with Analog Integrated Circuits*", Prentice Hall India Pvt. Ltd. Latest Edition.

[2] Denton J Dailey, "*Operational Amplifiers and Linear Integrated Circuits: Theory and Applications*", McGraw Hill Ltd, Latest Edition.

E-resources and other digital material:

[1] https://nptel.ac.in/courses/117101106

20HS4105–UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

Course Category:	Humanities and Social Sciences	Credits:	3
Course Type:	Mandatory course (suggested by AICTE)	Lecture-Tutorial-Practice:	2-1-0
Prerequisites:	Universal Human Values 1 desirable	Continuous Evaluation: Semester End Evaluation: Total Marks:	50M 50M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	Understand and aware of themselves and their surroundings (family, society and nature).
CO2	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3	Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.
CO4	Apply what they have learnt to their own self in different day-to-day settings in real life.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1			2					
CO2			3											
CO3						2								
CO4								3				2		

Course Content

UNIT-I **[Text Book-1]**

Course Introduction, Need, Basic Guidelines, Content and Process for Value Education:

Part-1: Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?its content and process, 'Natural acceptance' and experiential validation- as the process for self-exploration, continuous happiness and prosperity – a look at basic human aspirations.

Part-2: Right understanding, relationship and physical facility – the basic requirements for fulfillment of aspirations of every human being with their correct priority, understanding happiness and prosperity correctly – a critical appraisal of the current scenario, method to fulfill the above human aspirations-understanding and living in harmony at various levels.

(Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

UNIT-II **[Text Book-1]**

Understanding Harmony in the Human Being – Harmony in Myself:

Part-1: Understanding human being as a co-existence of the sentient 'I' and the material 'Body', understanding the needs of self ('I') and 'Body'– happiness and physical facility, understanding the body as an instrument of 'I' (I being the doer, seer and enjoyer).

Part-2: Understanding the characteristics and activities of 'I' and harmony in 'I', understanding the harmony of I with the Body-sanyam and health, correct appraisal of physical needs, meaning of prosperity in detail, programs to ensure sanyam and health.
(Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one's own life, differentiate between prosperity and accumulation, discuss program for ensuring health vs. dealing with disease).

UNIT-III **[Text Book–1]**

Understanding Harmony in the Family and Society–Harmony in Human-Human Relationship:

Part-1: Understanding values in human-human relationship, meaning of justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness, trust and respect as the foundational values of relationship, understanding the meaning of trust, difference between intention and competence, understanding the meaning of respect, difference between respect and differentiation, the other salient values in relationship.

Part-2: Understanding the harmony in the society (society being an extension of family), resolution, prosperity, fearlessness (trust) and co-existence as comprehensive human goals, visualizing a universal harmonious order in society–undivided society, universal order–from family to world family.
(Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. gratitude as a universal value in relationships, discuss with scenarios, elicit examples from students' lives).

UNIT-IV **[Text Book-1]**

Part-1:Understanding Harmony in Nature & Existence–whole existence as coexistence: Understanding the harmony in the nature, interconnectedness and mutual fulfillment among the four orders of nature–recyclability and self-regulation in nature, understanding existence as co-existence of mutually interacting units in all-pervasive space, holistic perception of harmony at all levels of existence.

Part-2: Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, sefinitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations.

(Part-1:Practice sessions are to be included to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology, etc.)
(Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions

e.g. to discuss the conduct as an engineer or scientist, etc.).

Text books:

[1] R. R. Gaur, R. Sangal and G. P. Bagaria, "*Human values and professional ethics*", Excel Books Private Limited , New Delhi , 2010

Reference Books:

[1] A. Nagaraj, "*JeevanVidya: EkParichaya*", JeevanVidyaPrakashan, Amarkantak, 1999

[2] A. N. Tripathi, "*Human Values*", New Age International Publishers, New Delhi, 2010.

[3] Annie Leonard, "*The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better*", Free Press, New York 2010.

[4] Mohandas Karamchand Gandhi, "*The story of my experiments with truth: Mahatma Gandhi Autobiography*", B. N. Publishing, 2008.

[5] E. F. Schumacher, "*Small is beautiful: A study of economics as if people mattered*", Vintage Books, London, 1993.

[6] Cecile Andrews, "*Slow is beautiful: New Visions of Community*", New Society Publishers, Canada 2006.

[7] J. C. Kumarappa, *"Economy of Permanence*", Sarva-Seva-SanghPrakashan, Varanasi, 2017.

[8] 2. K. Gandhi, "*Hind Swaraj or Indian Home Rule*", Navajivan Publishing House, Ahmedabad 1909.

[9] MaulanaAbulKalam Azad, "*India Wins Freedom: The Complete Version*", Orient Black swan, 1988.

[10] Romain Rolland, "*Mahatma Gandhi: The Man who become one with the Universal Being*", Srishti Publishers & Distributors, New Delhi, 2002.

E-resources and other digital material:

[1] AICTE – SIP Youtube Channel:https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ.

[2] AICTE – UHV Teaching Learning Material:

https://fdp-si.aicte-india.org/download.php#1

20EE4351-ELECTRICAL MACHINES-II LAB

Course Category:	Program Core	Credits:	1.5
Course Type:	Practice	Lecture-Tutorial-Practice:	0-0-3
Prerequisites:	Electrical Machines-I Lab (20EE3352)	Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze** and present experimental results.
CO3	**Exhibit** professional behavior.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3			3	2	3		3	3	
CO2	2	2	3	3	3			3	2	3			3	
CO3			3					3	2	2				

Course Content

1. Regulation of 3-phase alternator by EMF and MMF methods
2. Load test on 3-phase alternator.
3. Synchronization of three phase alternator with infinite bus bar.
4. Slip test and V & inverted V curves of 3-phase synchronous motor.
5. Load test on 3-phase squirrel cage/Slip ring induction motor.
6. No load and blocked rotor tests on 3-phase induction motor(equivalent circuit &circle diagram)
7. Load test on Induction generator.
8. Determination of equivalent circuit of single phase induction motor.
9. Simulation of three phase alternator to analyze the performance characteristics.
10. Simulation of 1-Φ/3-Φ squirrel cage induction motor to analyze the performance characteristics
11. Modeling and simulation of three phase Induction motor.
12. Simulation for speed control of 3-Φ squirrel cage induction motor(pole changing, variable voltage, rotor resistance in slip ring)

NOTE**: (A** minimum of **ten** experiments are to be completed in which minimum two simulation experiment mandatory.)

20EE4352-MEASUREMENTS AND CONTROL SYSTEMS LAB

Course Category:	Program Core	Credits:	1.5
Course Type:	Practice	Lecture-Tutorial-Practice:	0-0-3
Prerequisites:		Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze**and present experimental results.
CO3	**Exhibit** professional behaviour.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3			3	2	3		3		3
CO2	2	2	3	3	3			3	2	3				3
CO3			3					3	2	2				

Course Content

LIST OF EXPERIMENTS.

PART-A: Sensors and measurements

1. Study and observe the oscilloscope as a test and measuring instrument.(Test the resistors, capacitors, diodes, transistors and measure AC/DC voltages, frequency, phase and study the Lissajous patterns).
2. Measurement of ratio error and phase angle error of C.T.
3. Characteristics of (resistive and thermo e.m.f.) temperature sensor, and piezoelectric system.
4. Measurement of displacement using LVDT and characteristics of hall-effect sensor.
5. Measurement of strain using strain gauge andtemperature measurement using LM35 & thermistor.
6. Speed measurement using magnetic sensor and displacement measurement using inductive pickup
7. Measurement of power and energy in digital meters with CTs
8. Data acquisition from energy meter using RS232/RS485.
9. Simulation of CRO, function generator and spectrum analyzer using analog discovery kit.

PART-B:Control Systems

1. Transfer function of DC motor/generator and its simulation
2. Time response of second order system.
3. Realization of PI and PID controller.
4. Simulate the performance of given transfer function using Root locus, Bode plot and Nyquist plot.
5. Design a suitable compensator to improve the performance of a second order system
6. State space analysis for higher order system using a simulation tool

7. Characteristics of Synchros

NOTE:

1. In all laboratories a minimum of **ten** experiments are to be completed.
2. **Minimum Five** experiments from **PART-A** and **PART-B** are to be completed.

20EE4353 –LINEAR INTEGRATED CIRCUITS LAB

Course Category:	Program Core	Credits:	1.5
Course Type:	Practice	Lecture-Tutorial-Practice:	0-0-3
Prerequisites:		Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Evaluate** and **Analyze** experimental results.
CO3	**Exhibit** professional behavior.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	3			3	2	3		3		3
CO2	2	2	3	3	3			3	2	3				3
CO3			3					3	2	2				

Course Content

List of Experiments:

1. Measurement of op-amp parameters.
2. Applications of op-amp – inverting amplifier, adder, subtractor, comparator.
3. Design a precision full wave rectifiers using Op-Amp 741IC
4. Design of integrator & differentiator using op-amp.
5. Realization of instrumentation amplifier using op-amp.
6. Design a waveforms generator (square &triangular)using op-amp.
7. Design of clipper and clamper circuits using op-amp.
8. Design of active filters using op-amp (LPF & HPF-first order).
9. IC 555 timer as mono-stable and astable operation..
10. IC 565 PLL applications.
11. Realization of voltage regulators using IC 7805 , IC 7905 and IC 723
12. Design a D/A converter using 3 bit R-2R ladder circuit.

Note: - Realizing all the above experiments using different types of ICs.

20TP4106-ENGLISH FOR PROFESSIONALS

Course Category:	**Soft Skills**	**Credits:**	1
Course Type:	Learning by Doing	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:		**Continuous Evaluation:**	100M
		Semester End Evaluation:	0M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Present** themselves effectively in the professional world by shedding off their inhibitions about communicating in English
CO2	**Introduce** themselves as well as others appropriately.
CO3	**Use** vocabulary to form sentences and narrate stories by using creative thinking skills
CO4	**Involve** in practical activity oriented sessions.
CO5	**Learn** about various expressions to be used in different situations.
CO6	**Respond** positively by developing their analytical thinking skills.

Contribution of Course Outcomes towards achievementof Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3	3			
CO2									3	3	3			
CO3										3	3			
CO4								2		3	3			
CO5										3	3			
CO6										3	3			

Course Content

UNIT-I

1. Beginners, functional, situational conversations.
2. Practicing on functional conversations.

UNIT-II

1. Errors in usage of parts of speech with a thrust on verbs, adjectives and conjunctions, idioms/phrases.
2. Introducing basic grammar.
3. Practicing on functional conversations.

UNIT-III

1. Introducing self &others.
2. Structures and forming sentences.
3. Telephonic etiquette, social etiquette and table manners.
4. Practicing on functional conversations.

UNIT-IV

1. Direct, indirect/ reporting speech
2. Public speaking basics
3. Versant test preparation

4. Practicing on situational conversations.

Text Books:

[1] Swaroopa Polineni, "*Strengthen Your Communication Skills*", Maruthi Publications, 1st edition, 2013.
[2] Mamta Bhatnagar &Nitin Bhatnagar, **"***Communicative English***",** Pearson India, 1st edition,2010.

20EE4654–DESIGN THINKING

Course Category:	Skill Oriented Course	Credits:	2
Course Type:	Lab	Lecture-Tutorial-Practice:	1-0-2
Prerequisites:	Any Bachelors Degree pursuing in Engineering, Technology, Business, Architecture and Humanities	Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the history of design thinking.
CO2	**Understand** empathize for defining the societal related problem
CO3	**Understand** analyze phase
CO4	**Understand** the procedure for solve and testing of prototype

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1												**3**		
CO2						**3**			**3**	**3**				
CO3		**3**		**3**			**3**							
CO4			**3**					**3**			**3**			

Course Content

UNIT-I **[Text Book-1]**
Introduction to design thinking, history of design thinking, introduction to demo problem.

UNIT-II **[Text Book-1]**
Empathize phase, customer journey mapping, workshop on empathize, interviews (Activity).

UNIT-III **[Text Book–1]**
Analyze Phase: 5-whys and how might we..., conflict of interest, workshops on analysis..

UNIT-IV **[Text Book-1]**
Solve Phase: Ideation, free brainstorming &make/test phase, prototype, customer reactions to proto type, workshop on solve and test .

Text books:
[1]. Prof. BalaRamadurai , "Karmic Design Thinking".

E-resources and other digital material:
[1] https://nptel.ac.in/courses/110/106/110106124/

20MC4108A - ENVIRONMENTAL STUDIES

Course Category:	Humanities and Social Sciences	Credits:	-
Course Type:	Theory Mandatory course	Lecture-Tutorial-Practice:	2-0-0
Prerequisites:	Consciousness of Environment	Continuous Evaluation: Semester End Evaluation: Total Marks:	100M - 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	Identify various factors causing degradation of natural resource and control measures.
CO2	Identify various ecosystem and need for biodiversity.
CO3	Realize and explore the problems related to environmental pollution and its management.
CO4	Apply the information and technology to analyze social issues, use acts associated with environment.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1							1						
CO2		1	1							1				
CO3				1	1							1		
CO4						1	1	1						

Course Content

UNIT-I **[Text Book-1]**

The Multidisciplinary Nature of Environmental Studies -Definition, scope and importance Need for public awareness.

Natural Resources :

Renewable and Non-Renewable Resources: Natural resources and associated problems.
(a)Forest Resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people.
(b)Water Resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c)Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.
(d)Food Resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
(e)Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.
(f)Land Resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, role of an individual in conservation of natural resources, equitable use of resources for sustainable lifestyles.

UNIT-II **[Text Book-1]**

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers

and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity and Its Conservation: Introduction, definition: genetic, species and ecosystem diversity. Biogeographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT-III **[Text Book–1]**

Environmental Pollution: Definition, causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards.

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Disaster Management: Floods, earthquake, cyclone and landslides.

UNIT-IV **[Text Book-1]**

Social Issues and the Environment: From unsustainable to sustainable development. Urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people; its problems and concerns.

Environmental Ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, wasteland reclamation, Consumerism and waste products.

Environment Protection Act: Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, wildlife protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation.

Public Awareness: Human population and the environment, population growth, variation among nations, population explosion—family welfare program me.

Environment and Human Health: Human rights, Value education, HIV/AIDS, women and child welfare, role of information technology in environment and human health.

Field Work/ Case Studies: Visit to a local area to document environmental assets-river/forest/grassland/hill/mountain, visit to a local polluted site-Urban/Rural/Industrial /Agricultural, study of common plants, insects, birds, study of simple ecosystems-pond, river, hill slopes, etc.

Self-Study: Water resources, Threats to biodiversity, Solid waste management, Role of Information Technology in environment and human health.

Text books:

[7]. ErachBharucha, "*Environmental Studies for undergraduate courses*", University Grants Commission, New Delhi, BharatiVidyapeeth Institute of Environment Education and Research,2004.

Reference Books:

[1] AnjaneyuluY, "*Introduction to Environmental sciences*", BS Publications private Ltd, Hyderabad.

[2] Anjireddy,"*Environmental science & Technology*", BS Publications private Ltd, Hyderabad.

[3] Benny Joseph, "*Environmental Studies*", The Tata McGraw- Hill publishing companyLtd., New Delhi, 2005.

[4] P.VenuGopalaRao, "*Principles of Environmental Science. &Engg.*", Prentice-Hall of India Pvt. Ltd., New Delhi, 2006.

[5] Santosh Kumar Garg, RajeswariGarg,RajaniGarg, "*Ecological and Environmental Studies*",Khanna Publishers, New Delhi, 2006.

[6] Kurian Joseph & R Nagendran, "*Essentials of Environmental Studies*", Pearson Education Publishers, 2005.

[7] A.K Dee, "Environmental Chemistry", New Age India Publications
[8] BharuchaErach, "Biodiversity of India", Mapin Publishing Pvt.Ltd.

E-resources and other digital material:

[1] https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
[2] NPTEL Courses-Environmental Studies By Dr.TusharBanerjeeDeviAhilyaViswavidyalaya, Indore

SEMESTER V **CONTACT HOURS: 33**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE5301	Program Core	Microcontrollers	3	0	0	3
2	20EE5302	Program Core	Power Electronics	3	0	0	3
3	20EE5303	Program Core	Power Generation and Transmission	2	0	0	2
4	20EE5404	Program Elective 1	A. Advanced Control Systems B. Solar Photovoltaics C. Artificial Neural Networks and fuzzy Logic D. Data Communication and Networking	3	0	0	3
5	20EE5205	Open Elective/Job oriented elective-1	A. Waste to Energy Conversion Technology B. Electrical Energy Conservation & Audit	3	0	0	3
6	20EE5351	Program Core Lab 1	Power Electronics Lab	0	0	3	1.5
7	20EE5352	Program Core Lab 2	Microcontrollers Lab	0	0	3	1.5
8	20EE5353	Program Core Lab 3	IoT Lab	0	0	3	1.5
9	20TP5106	**Soft Skills – 3**	Personality Development	0	0	2	1
10	20EE5354	Internship/ Project (6 weeks)	EPICS/Internship	0	0	3	1.5
11	20EE5607	**Skill Oriented Course-2**	**Data Structures Lab**	1	0	2	2
12	20MC5108B	Mandatory Course (AICTE suggested)	Innovation, IPR & Entrepreneurship	2	0	0	-
Total				**17**	**0**	**16**	**23**
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				**4**	**0**	**0**	**4**

L–Lecture, **T**– Tutorial, **P** –Practical, **C**-Credits

Category	**Credits**
Program Core Courses	12.5
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented courses	3
Internship / Project	1.5
Mandatory Course	0
TOTAL CREDITS	**23**

20EE5301– MICROCONTROLLERS

Course Category:	**Program Core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Digital Electronics (20EE3305)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Illustrate** the concept of embedded systems and architecture of 8051 microcontroller.
CO2	**Composition** of different features on 8051 microcontroller.
CO3	**Illustrate** the architecture and programming of AVR microcontroller.
CO4	**Interfacing** of basic I/O devices.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**											**3**		**3**
CO2	**3**		**2**		**3**							**3**		**3**
CO3	**3**				**3**							**3**		
CO4	**3**		**2**		**3**							**3**		**3**

Course Content

UNIT-I **[Text Book-1&2]**

Introduction to Embedded Technology: Introduction to microprocessors and microcontrollers, differences between microprocessor & microcontrollers, types of microcontrollers based on architecture- RISC and CISC.

8051 Microcontroller Hardware: Features of 8051 family, architecture and pin configurations of 8051 controller, register organization, memory organization, and addressing modes.

UNIT-II **[Text Book-1&2]**

8051 On-chip Peripherals Interfacing [Using Embedded C]:

Timers/counters -Timer and counter operation, Register configuration, modes of operation, programming in mode1 and mode2.

Serial port (UART): Types of serial communications, Register configuration, modes of operation, programming in mode1.

Interrupts: Register configuration, programming of external hardware interrupts, timer and serial communication interrupts, interrupt priority and programming.

UNIT-III **[Text Book-3]**

AVR Microcontrollers [ATMEGA328P]: Introduction, features of microcontroller, pin-diagram and block-diagram of ATMEGA328P controller, register organization, memory organization.

Introduction to ATMEGA328P Programming using generic development board: Introduction to embedded C, basic I/O instructions, loop instructions, conditional jump instructions.

UNIT-IV **[Text Book–2&3]**

External Peripherals Interfacing [using Embedded C]: Interfacing of general purpose LED, Pushbutton, 4x4 Hex-keyboard, seven segment LED, 16x2 LCD, relay and temperature sensor using both 8051 and ATMEGA328P development board, ADC808, DAC800 programming using 8051.

Text Books:

[1] Ayala and Kenneth J., "*The 8051 Microcontroller: Architecture, Programming and Applications*", West Publishing Company, 2007.

[2] M.A. Mazidi, J.G. Mazidi and R.D.McKinlay, "*The 8051 Microcontroller and Embedded Systems using Assembly and C*", Pearson Education, 2nd Edition, 2006

[3] Richard.H. Barnett, sarah Cox and Larry O'Cull*," Embedded C Programming and the Atmel AVR*", Delmar Cenage Learning, 2nd Edition, 2012

Reference Books:

[1] Subrata Ghoshal, "*8051 Microcontroller: Internals, Instructions, Programming and Interfacing*", Pearson Education, 2010.

[2] A.V. Deshmukh, "*Microcontrollers Theory and Applications*", Tata McGraw Hill, 2005.

[3] Kenneth Ayala and Kenneth J. Ayala, "The *8086 Microprocessor: Programming and Interfacing the PC*", West Publishing Company, 1995.

E-resources and other digital material:

[1] www.8052.com under tutorial section

[2] Data sheet of ATMEGA328P:
"http://ww1.microchip.com/downloads/en/DeviceDoc/ATmega48A-PA-88A-PA-168A-PA-328-P-DS-DS40002061A.pdf

[3] https://www.avr-tutorials.com/

20EE5302-POWER ELECTRONICS

Course Category:	**Program Core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Electronic Circuits (20EE3302), Network Analysis-I & II (20ES2104E & 20ES3104)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the theory of various power electronic devices.
CO2	**Analyze** the operation of AC and DC converters.
CO3	**Elucidate** the operation of various DC and AC choppers.
CO4	**Analyze** the operation of various inverters**.**

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**2**		**2**	**2**									**2**
CO2	**2**	**3**		**3**	**2**				**3**					**3**
CO3	**2**	**3**		**3**	**2**				**3**					**3**
CO4	**2**	**3**		**3**	**2**				**3**					**3**

Course Content

UNIT-I **[Text Book-1]**

Power semiconductor& switching devices: Power electronic devices-Introduction, characteristics of ideal switch, real switch, V-I characteristics of power diodes, Silicon Controlled Rectifier (SCR), Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and Insulated Gate Bipolar Transistor (IGBT), two transistor model of SCR, turn ON methods of SCR, turn OFF methods of SCR (voltage commutation), snubber protection for SCR, quadrant operation of power semiconductor devices.

UNIT-II **[Text Book–1]**

AC to DC converters: Introduction, single phase fully controlled bridge rectifier with R, pure inductor, RL and RLE loads-effect of source inductance performance parameters of converters.

Three Phase Converters: Three phase uncontrolled and fully controlled bridge converters with R, RL loads.

UNIT-III **[Text Book-1]**

AC to AC Regulators: Introduction-single phase two SCRs in anti-parallel– with R and

RL loads–derivation of RMS load voltage, current and power factor.
DC to DC converters: Introduction, Chopper classification, time ratio control, buck converter, boost converter, buck-boost converters – Voltage and Current ripple calculations and design of L & C for all converters.

UNIT-IV **[Text Book-1]**
DC to AC converters: Introduction, single phase full bridge inverters, comparison between VSI & CSI, three phase VSI (180 &120-degree conduction modes).
Voltage control techniques for inverters: Pulse-width modulation techniques - single pulse, multi-pulse, sinusoidal pulse width modulation techniques.

Text Book:

[1] P.S. Bhimbra, "*Power Electronics Circuits, Devices and Applications*", Khanna Publications, 5th Edition 2011.

Reference Books:

[1] Ned Mohan, Tore M. Undeland, and William P. Robbins, "*Power Electronics Converters Applications and Design*", Wiley Publications, 3rd Edition, 2003
[2] Ramnarayana, "*Course Material on Switched Mode Power Conversion*", IISc. Bangalore.
[3] M. H. Rashid, "*Power Electronics: Circuits Devices and Applications"*, Pearson, 4th Edition, 2011
[4] M.D. Singh and K.B. Kanchandani "*Power Electronics*", McGraw Hill Publications, 2nd Edition, 2008

E-resources and other digital material:

[1] www.nptel.ac.in/courses/108101038/

20EE5303-POWER GENERATION AND TRANSMISSION

Course Category:	**Program Core**	**Credits:**	2
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Prerequisites:	Engineering Physics (20BS2102A) Network Analysis-I (20ES2104E)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the layout of power system and **Elucidate** conventional power generating plants.
CO2	**Analyze** the performance of transmission lines.
CO3	**Design** insulators and underground cables.
CO4	**Understand** the economical aspects of power generation.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**						**3**						**3**	
CO2	**3**	**2**											**3**	
CO3	**2**												**3**	
CO4	**2**	**2**											**3**	

Course Content

UNIT-I **[Text Book–1&2]**

Thermal and Hydroelectric power stations: Introduction - selection of site for thermal station-main parts and working; factors for site selection of hydroelectric station - general arrangement and operation of hydroelectric plants- functions of different components in storage reservoir plants.

Nuclear power stations: Introduction-main parts of reactors and their functions-types of reactors-Boiling Water Reactor (BWR) and Pressurized Water Reactor (PWR)-working of nuclear power stations.

UNIT-II **[Text Book–1&2]**

Performance of transmission lines: Introduction - Representation of short, medium and long length transmission lines- ABCD constants for short lines-General network constants for medium lines-Ferranti effect-surge impedance and surge impedance loading- corona.

UNIT-III: **[Text Book-1]**

Mechanical Design and Insulators: Introduction and definition of sag, insulators-Introduction-insulator materials-types of insulators - Potential distribution over a string of suspension insulators-methods of increasing string efficiency.

Underground Cables: Types of cables, Insulation resistance-stress in insulation and capacitance of single core cable-use of inter sheath-capacitance grading-capacitance of three core cable.

UNIT-IV **[Text Book-1]**

Economical aspects: Economics of generation-significance of load curve-load duration curve-load factor, diversity factor, plant use factor, factors affecting the cost of generation-tariffs.

Text Books:

[1] M.L. Soni, P.V. Gupta, U.S. Bhatnagar and A. Chakraborti, "*Power System Engineering*", DhanpatRai& Co. Pvt. Ltd., 2016.

[2] C.L. Wadhwa, "*Electrical Power Systems*", New age International Publishers,7th Edition, 2009

Reference Books:

[1] John J.Grainger and William D. Stevenson, *"Power System Analysis*", Mc.Graw Hill, 4th Edition 1994.

[2] V.K. Mehta, Rohit Mehta, "*Principles of Power Systems*", S. Chand, 4th Edition, 2008.

[3] J.B. Gupta, "*Transmission & Distribution of Electrical Power*", S. K. Kataria & Sons, 2013.

[4] Kothari and Nagrath, "Power System Engineering", Tata Mc.Graw Hill, 2nd Edition 2008.

E-resources and other digital material:

[1] https://nptel.ac.in/courses/108105104

[2] https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-to-electric-power-systems-spring-2011

20EE5404A –ADVANCED CONTROL SYSTEMS

Course Category:	**Programme Elective-1**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Linear Control Systems (20EE4302) Matrices and Differential Calculus (20BS1101)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** and **Design** MIMO systems by state space approach .
CO2	**Investigate** the systems with common nonlinearities using describing function.
CO3	**Examine** stability of linear and non – linear systems using Lyapunov's method.
CO4	**Understand** the fuzzy set theory and **Design** controllers using Fuzzy logic.

Contribution of Course Outcomes towards achievement of Program Outcomes (L - Low, M - Medium, H - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**	**3**	**2**										**2**
CO2	**3**	**2**												**1**
CO3	**3**	**2**	**2**											**2**
CO4	**3**	**2**	**3**						**2**					**3**

Course Content

UNIT-I **[Text Book No-1]**

State Variable Analysis: State Space Representation, solution of state equation, state transition matrix, controllable canonical form, observable canonical form, Jordan canonical form, controllability and observability, effect of state feedback on controllability and observability.

Design in state space: Design of state feedback control through pole placement, full order observer and reduced order observer.

UNIT-II **[Text Book No-1]**

Introduction to Non Linear Systems: Introduction, features of linear and non linear systems, types of nonlinearities, common physical nonlinearities in control systems-relay, dead zone, saturation, friction, backlash, hysteresis.

Describing Function Analysis: Describing function fundamentals, describing functions of common nonlinearities, describing function analysis of nonlinear systems, limit cycles, stability of oscillations.

UNIT-III **[Text Book No-1]**

Lyapunov Stability Analysis: Stability concepts, equilibrium points, terminology of Lyapunov's stability, stability in the sense of Lyapunov, asymptotic stability, globally asymptotically stable, instability, direct method of Lypanov for the linear autonomous systems, stability analysis of nonlinear systems using Krasoviskii method.

UNIT-IV **[Text Book No-1]**

Fuzzy Control: Introduction, model-based control vs. rule-based control, Crisp vs. fuzzy relations, premise (antecedent) and conclusion (consequent) rules, basic components of fuzzy logic, fuzzy sets, fuzzification, Knowledge base, decision making logic, membership functions, rule base, de-fuzzification, madman fuzzy rules, Takagi- Sugeno fuzzy rules, designing a fuzzy logic controller - step-by-step procedure for designing an cruise controller for controlling speed of an automotive.

Text Book:

[1] I.J. Nagrath & M. Gopal, "*Control Systems Engineering*", New Age Int.(P), 5th Edition, 2007.

Reference Books:

[1] K. Ogata, "*Modern Control Engineering*", PHI, 5th Edition, 2010
[2] M. Gopal, "*Modern Control System Theory*", New Age, 3rd Edition, 2014.
[3] Rajasekharan and Vijaya lakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and applications", PHI, 15th printing, 2011

E-resources and other digital material:

[1] https://nptel.ac.in/courses/108103007/

20EE5404B-SOLAR PHOTOVOLTAICS

Course Category:	**Program Elective-1**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Network Analysis-I (20ES2104E) Electronics Circuits (20EE3302) Environmental Studies (20MC4108A)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the concepts of solar cell.
CO2	**Understand** the solar cell characteristics.
CO3	**Understand** the concept of solar radiation and photovoltaic modules.
CO4	**Design** concepts of solar photovoltaic systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**		**1**	**1**			**1**	**2**				**2**		1
CO2	**3**		**1**	**1**			**1**	**2**				**2**		1
CO3	**3**		**1**	**1**			**1**	**2**				**2**		1
CO4	**3**		**1**	**1**			**1**	**2**				**2**		2

Course Content

UNIT-I **[TextBook-1]**

Introduction to Solar Cells: Fossil fuel energy usage and global warming, role of renewable energy in sustainable development, renewable energy sources, global potential for solar electrical energy systems, introduction to solar photovoltaic, place of solar photovoltaic in energy supply, sun and earth movement-declination angle, inclination angle, zenith angle, hour angle, apparent motion of the sun and solar altitude, angle of sun rays on solar collector.

UNIT-II **[Textbook-1]**

Solar Cell Characteristics and Performance: PN junction equilibrium condition, space charge region, energy band diagram of PN junction, PN junction potential, width of depletion region, carrier movements and current densities, PN junction under illumination-generation of photo voltage, light generated current, solar cell

characteristics-I-V relation, P-V Characteristics, limits of cell parameters-short circuit current, open circuit voltage, maximum voltage, maximum current, maximum power, fill factor, efficiency, losses in solar cells-simple calculation in efficiency of solar cell.

UNIT-III **[Textbook-1]**

Solar Radiation and Photo Voltaic Modules: Sun tracking, solar PV modules from solar cells, series connection, parallel connection-mismatch in series and parallel connections, effect of shading, feedback diode, blocking diode, influence of temperature, PV module power output, types of solar cells.

UNIT-IV **[Textbook-1]**

Solar Photo Voltaic System Design and Applications: Introduction to solar PV systems, stand-alone PV system configuration, stand-alone system with battery and AC (or) DC load case study problems, grid-connected PV systems configuration-working of a grid-connected system, example-single stage grid connected-simple problems related to design of standalone PV system and grid-connected PV systems-case study.

Text Book:

[1] Ch.S.Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications'', Prentice Hall of India, 3rd Edition, 2015.

Reference books:

[1] B.H.Khan, "*Non Conventional Energy Resources*", Mc.Graw Hill Education private limited, New Delhi, 2nd Edition, 2009.
[2] K.Mertens, "*Photovoltaic Fundamentals Technology and Practice*", John and Willey publishers, 2nd Edition, 2018.
[3] M.Jamil, M.Rizwan, D.P.Kothari, "*Grid Integrated Solar Photovoltaic Systems*", CRC press, Taylor and Francis, 2018.

E-resources and other digital material

[1] https://www.nptel.ac.in/courses/115107116
[2] https://www.nptel.ac.in/courses/112105051

20EE5404C-ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC

Course Category:	**Programme Core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	**Linear Control Systems (20EE4302)** **Electrical Machines-II (20EE4303)**	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

Upon successful completion of the course, the student will be able to:

CO1	**Know** The concepts of neural networks and its terminology
CO2	**Understand** the rules and algorithms if neural networks
CO3	**Know** the fuzzy set theory and **Design** controllers using Fuzzy logic.
CO4	**Apply** the knowledge of fuzzy logic and Neural networks in various applications

Contribution of Course Outcomes towards achievement of Program Outcomes (L - Low, M - Medium, H - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1				2									
CO2	2				2									
CO3	1				2									
CO4	3		2		2									2

Course Content

UNIT- I **[Text Book-1]**

Artificial Neural Networks: introduction, biological neuron, artificial neuron, basic concepts of neural networks, basic models of ANN connections, Mcculloch-pitts model, characteristics of ANN, applications of ANN, artificial neuron model, operations of artificial neuron, types of neuron activation function, ANN architectures, classification taxonomy of ANN – connectivity, neural dynamics (activation and synaptic),

UNIT-II **[Text Book-1]**

Supervised Learning Networks: Learning Strategy (supervised, unsupervised, reinforcement), learning rules, types of application perceptron network, perceptron learning rule, architecture, perceptron training algorithm, ADALINE, MADALINE, back propagation network, bp learning rule, input layer computation, hidden layer computation, output layer computation, radial basis function.

UNIT-III **[Text Book-1,2]**

Fuzzy Logic & Control: Fuzzy Logic Systems- basics of fuzzy logic theory, crisp and fuzzy sets, basic set operations, fuzzy relations, composition of fuzzy relations, fuzzy inference, Zadesh's compositional rule of inference. defuzzificaiton, Fuzzy logic control-Mamdani and Takagi and Sugeno architectures, applications to pattern recognition and control.

UNIT-IV **[Text Book-3]**

Applications of Neural Networks: Neural network applications in image processing and compression, control systems-induction motor control, pattern recognition.

Applications of Fuzzy Logic: Fuzzy C-Means Algorithm, switched reluctance motor control, automatic voltage regulation, fuzzy logic controller in level control.

Text Books:

1. Sivanandam.S.N and Deepa.S.N: *Principles of Soft Computing*, Wiley India, 1st Edition,2008
2. Rajasekharan and Pai, "*Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and Applications"*, PHI Publications. 2011
3. Sivanandam SN, Deepa SN. "Introduction to neural networks using Matlab 6.0" Tata McGraw-Hill Education; 2006.

Reference Books:

1. B.Yegnanarayana, " Artificial Neural Networks ", PHI Learning Pvt. Ltd, 1st Edition, 2012.

E-resources and other digital material

[1] https://nptel.ac.in/courses/127105006/

20EE5404D-DATA COMMUNICATION AND NETWORKING

Course Category:	**Program Elective-I**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Demonstrate** various standard network models.
CO2	**Analyze** error detection and error correction codes**.**
CO3	**Understand** routing issues in network design.
CO4	**Analyze** the underlying protocols in transport layer and **Identify** different applications in Application layer.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**													
CO2	**2**	**2**		**3**										
CO3	**3**	**1**	**1**	**3**										
CO4	**1**	**1**		**1**										

Course Content

UNIT-I **[Text Book-1]**

Introduction: Uses of computer networks, network hardware, LANs, MANs, WANs, network software**.**

Reference Models: The OSI reference model, TCP/IP reference model, the comparison of the OSI and TCP/IP reference models**.**

Physical Layer: Guided transmission media: magnetic media, twisted pair, coaxial cable, and fibre optics.

UNIT-II **[Text Book-1]**

Data Link Layer: Data link layer design issues, error detection and correction, elementary data link protocols, and sliding window protocols**.**

Medium Access Control Sub layer: The channel allocation problem, multiple access protocols, Ethernet**.**

UNIT-III **[Text Book-1]**

Network Layer: Network layer design issues, routing algorithms: shortest path,

flooding, DVR and link state routing algorithm, congestion control algorithms.
Quality of Service: Techniques for achieving good quality of service, IP Protocol, IP addresses, Internet control protocols.

UNIT-IV **[Text Book-1]**
Transport Layer: Transport service, elements of transport protocols, and the internet transport protocols TCP and UDP.
Application Layer: Domain Name System (DNS), and E-Mail.

Text Books:

[1] Andrew S Tanenbaum, "*Computer Network*", 4th Edition, Pearson Education, 2003

Reference Books:

[1] Kurose and Ross, "*Computer Networks – A Top-down Approach Featuring the Internet*", Pearson Education, 2017
[2] Behrouz A.Forouzan, "*Data Communications and Networking*". 4th Edition, TMH, 2001
[3] Nader F.Mir, "*Computer and Communication Networks*". PHI, 2014

E-resources and other digital material:

To be added

20EE5205A-WASTE TO ENERGY CONVERSION TECHNOLOGY

Course Category:	**Open Elective-I (General Elective)**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Environmental Studies (20MC4108A)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Explore** the usage of municipal solid waste, bio-medical waste and environmental aspects.
CO2	**Illustrate** the process for disposal of waste.
CO3	**Explore** the process of energy conversion from thermo-chemical waste.
CO4	**Explore** the process of energy conversion from bio-chemical waste.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**				**2**	**2**	**3**						**1**	
CO2	**2**					**2**	**3**						**1**	
CO3	**2**	**2**	**2**		**2**	**2**	**3**						**1**	
CO4	**1**		**2**			**2**	**3**						**1**	

Course Content

UNIT-I **[Text Book-1]**

Introduction to Waste & Waste Processing: Definitions, sources, types and composition of wastes, characterization and classification of waste as fuel- agro-based, forest residues, municipal solid waste, industrial waste-waste in the global context, municipal solid waste- physical, chemical and biological properties, waste collection and transfer stations, waste processing-size reduction, separation, waste management hierarchy, waste minimization and recycling of MSW.

Environmental and Health Impacts-Case Studies: Environmental and health impacts of waste to energy conversion, case studies of commercial waste to energy plants, waste to energy- potentials and constraints in India, eco-technological alternatives for waste to energy conversions - rules related to the handling, treatment and disposal of MSW and BMW in India.

UNIT-II **[Text Book-1]**

Waste Treatment and Disposal: Aerobic composting, incineration, different type of

incineration; medical and pharmaceutical waste incinerations- land fill classification, types, methods and silting consideration, composition, characteristics, generation, movement and control of landfill leachate and gases, environmental monitoring system for land fill gases. **(Case study).**

UNIT-III **[Text Book-1]**

Energy from waste-thermo chemical conversion: Sources of energy generation, incineration, pyrolysis, gasification of waste using gasifies, briquetting, utilization and advantages of briquetting - environmental and health impacts of incineration; strategies for reducing environmental impacts.**(Case study).**

UNIT-IV **[Text Book-2]**

Energy from waste- Bio-chemical Conversion: Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestion biogas production, land fill gas generation and utilization. **(Case study)**

Note: Case studies not to be included for main examination.

Text Books:

[1] Nicholas P Cheremisinoff, "*Handbook of Solid Waste Management and Waste Minimization Technologies*", An Imprint of Elsevier, New Delhi, 2003.
[2] Paul Breeze, "*Energy from Waste*", An Imprint of Elsevier, New Delhi, 2018.

Reference Books:

[1] C.Parker and T.Roberts (Ed.), "*Energy from Waste*", *An Evaluation of Conversion Technologies*, Elsevier Applied Science, London, 1985.
[2] Shah, Kanti L, "*Basics of Solid and Hazardous Waste Management Technology*", Prentice Hall, 2000.
[3] Manoj Datta, "*Waste Disposal in Engineered Landfills*", Narosa Publishing House, 1997

E-resources and other digital material:

[1] https://nptel.ac.in/courses/103107125/
[2] https://swayam.gov.in/course/3562-waste-to-energy-conversion

20EE5205B–ELECTRICAL ENERGY CONSERVATION AND AUDIT

Course Category:	**Open Elective–I**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Electrical Machines - I (20EE3303) Electrical Machines - II (20EE4303)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the concepts of energy conservation and energy auditing, methodology.
CO2	**Analyze** the energy economics and energy efficient motor performance.
CO3	**Analyze** the effect of energy efficient transformers and reactive power management.
CO4	**Evaluate** the advantages of demand side management.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**			**2**	**1**					**2**				**2**
CO2	**3**			**3**	**1**						**3**			**3**
CO3	**3**			**3**	**1**					**3**			**2**	
CO4	**2**			**3**	**1**					**1**			**3**	

Course Content

UNIT-I **[Text Book–1 & R1]**

Energy Conservation: Introduction, Energy conservation schemes, Energy Conservation act -2001 and its features, energy index, energy costs, cost index, representation of energy consumption, pie charts, sankey diagrams, load profile.

Energy Audit: Definitions, need of concepts, types of energy audit, energy audit report format, audit instruments, Lux meter, combustion analyzer, air flow measurement devices, energy auditing for industrial and commercial and residential units.

UNIT-II **[Text Book–2]**

Energy Economics: Introduction, cost benefit, risk analysis, payback period, straight line depreciation, sinking fund depreciation, reducing balance depreciation, net present value method, internal rate of return method.

Energy Efficient motors: Introduction, when to by efficient motors, motor losses and loss reduction techniques, determining and comparing motor efficiencies, determining annual energy savings, load matching and selection of motors, additional benefits to the energy efficient motors.

UNIT-III **[Text Book-1& E2]**

Energy Efficient Transformers: Introduction, Why energy-efficient transformers, Transformer loading, Improving the energy performances, efficiency analysis, testing and energy performance metrics, Minimum Energy Performance Standards (MEPS), MEPS for liquid filled and dry-type distribution transformer, IEC 60076 test methods, IEC recommended efficiency levels.

Reactive Power Management: Capacitor sizing, degree of compensation, capacitor losses, location-placement-maintenance, peak demand control methodologies and types of industrial loads, optimal load scheduling.

UNIT-IV **[Ref. Book–3 & E3]**

Demand Side Management: Introduction, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, time of day models for planning load management, load priority technique, peak clipping, peak shifting, valley filling, strategic conservation, energy efficient equipment.

Text Books:

[1] W.R.Murphy & G.Mckey Butterworths, "*Energy Management*", New Age International Publishers, 2013

[2] S.C. Tripathy, "*Electric Energy Utilization and Conservation*", Tata McGraw Hill, 1991.

Reference Books:

[1] Wayne C.Turner, "*Energy management Hand book*", John Wiley and Sons, 8th Edition, 2012

[2] John C. Andreas, "*Energy efficient electric motors selection and application*", Marcel Dekker Inc, 2018

[3] Gilbert A. McCoy and John G. Douglass, "*Energy efficient electric motors selection Hand book*", Jan 1993.

[4] Umesh Rathore, "*Energy Management*", S.K. Kataria & Sons, 2015.

[5] Amit Kumar Tyagi, "*Hand book on Energy Audit and Management*", TERI, 2012.

[6] Paul W.O. Callaghan, "*Energy Management*", McGraw Hill, 1993.

E-resources and other digital material:

[1] https://nptel.ac.in/courses/108/106/108106022/

[2] https://united4efficiency.org/wp-content/uploads/2017/11/U4E-TransformersGuide-201711-Final.pdf

[3] https://getmyuni.azureedge.net/assets/main/study-material/notes/electrical-engineering_engineering_electric-power-generation_demand-side-management_notes.pdf

20EE5351– POWER ELECTRONICS LAB

Course Category:	**Program core**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Power Electronics (20EE5302) Electronic Circuits (20EE3302)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and **conduc**t experiment.
CO2	**Evaluate** and **Analyze** experimental results.
CO3	**Exhibit** professional behavior.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				**2**					**3**	**2**				**2**
CO2				**2**					**3**	**2**				**2**
CO3								**2**						

Course Content

List of Experiments:

1. Static characteristics of SCR.
2. Static characteristics of MOSFET &IGBT.
3. Gate drive circuits for MOSFET / IGBT.
4. Single phase fully controlled bridge rectifier.
5. Single phase dual converter.
6. Three phase fully controlled rectifier.
7. Single phase AC voltage controller.
8. Single phase H-bridge inverter.
9. Single phase step down cyclo-converter.
10. Buck/Boost converter.

Additional Experiments:

1. Implementation of single phase full bridge inverter using FPGA.
2. Implementation of buck converter using FPGA.
3. Implementation of boost converter using FPGA.
4. Implementation of three phase voltage source inverter using FPGA.

Task: Developing microcontrollers-based gate drive circuits.

Minimum of 10 experiments are to be completed.

20EE5352-MICROCONTROLLERS LAB

Course Category:	**Program core**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Microcontrollers (20EE5301)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Evaluate** and **Analyze** experimental results.
CO3	**Exhibit** professional behavior.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				**3**	**3**				**3**					**3**
CO2				**3**	**3**				**3**					**3**
CO3				**3**	**3**				**3**					**3**

Course Content

Part A: Basic programming

1. Basic programs for understanding data transfers.
2. Basic programs for understanding arithmetic operations.
3. Basic programs for understanding conditional jump instructions.

Part B: Interfacing of Basic I/O using Arduino

1. Generic LED interfacing with different duty cycle blinking.
2. Interfacing of push button for reset and on/off operation.
3. Two-digit Seven Segment LED interfacing for loop timer for 99sec.
4. Interfacing of 16x2 LCD for displaying messages.
5. Interfacing of 4x4Hex keypad.
6. Interfacing of Temperature sensor using LM35 and 16x2 LCD.
7. Design of Password based relay.
8. Interfacing of STEPPER motor.

Part C: Hardware Interfacing with 8051

1. Generic LED interfacing with different duty cycle blinking

2. Interfacing of push button for reset and on/off operation.
3. Two-digit Seven Segment LED interfacing for loop timer for 99sec.
4. Interfacing of 16X2 LCD for displaying messages.
5. Interfacing of 4X4 Hex keypad.
6. Interfacing of Temperature sensor using LM35.
7. Serial communication with PC.
8. Interfacing of STEPPER motor using interrupts.

NOTE: A minimum experiments of **Five from Part B and Five from Part C** are to be conducted.

20EE5353-INTERNET OF THINGS LAB

Course Category:	**Program core**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Microcontrollers (20EE5301)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment
CO2	**Analyze** and present experimental results
CO3	**Exhibit** professional behavior

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				**3**	**3**				**3**					**3**
CO2				**3**	**3**				**3**					**3**
CO3				**3**	**3**				**3**					**3**

Course Content

List of Experiments

1. Digital I/O interface for controlling actuators using ESP8266.
2. Obstacle detection with Ultrasonic sensor by interfacing it with ESP8266.
3. Digital counter with IR sensors by interfacing it with ESP8266.
4. Fire detection with Gas Sensor by interfacing it with ESP8266.
5. Home automation with Esp8266 using IoT.
6. Smart parking Using IoT
7. LED blinking using RaspberryPi.
8. Temperature monitoring using RaspberryPi.
9. Moisture content detection in soil using RaspberryPi.
10. ON/OFF control of DC motor using RaspberryPi.
11. Security system with PIR sensor using RaspberryPi.
12. Weather monitoring system with RaspberryPi using IoT

NOTE: A minimum of **Ten** experiments should be conducted from the above list**.**

20TP5106–PERSONALITY DEVELOPMENT

Course Category:	**Soft skill-3**	**Credits:**	1
Course Type:	Learning by doing	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	--	**Continuous Evaluation:**	100M
		Semester End Evaluation:	--
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the corporate etiquette.
CO2	**Make** presentations effectively with appropriate body language.
CO3	**Composed** with positive attitude.
CO4	**Understand** the core competencies to succeed in professional and personal life.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								**2**		**3**				
CO2									**2**	**3**				
CO3										**3**				
CO4									**2**	**3**				

Course Content

UNIT-I

Analytical Thinking & Listening Skills: Self-Introduction, shaping young minds - A Talk by Azim Premji (Listening Activity), self – analysis, developing positive attitude, perception.

Communication Skills: Verbal communication; non-verbal communication (Body Language).

UNIT-II

Self-Management Skills: Anger Management, stress management, time management, six thinking hats, team building, leadership qualities.

Etiquette: Social etiquette, business etiquette, telephone etiquette, dining etiquette.

UNIT-III

Standard Operation methods: Note making, note taking, minute's preparation, e-mail & letter Writing.

Verbal ability: Synonyms, antonyms, one-word substitutes-correction of sentences-analogies, spotting errors, sentence completion, course of action-sentences assumptions, sentence arguments, reading comprehension, practice work.

UNIT-IV

Job-Oriented Skills-I: Group discussion, mock group discussions.

Job-oriented skills–II: Resume preparation, interview skills, mock interviews.

Text Books:

[1] Barun K. Mitra, "*Personality Development and Soft Skills*", Oxford University Press, 1st Edition, 2011.

[2] Meenakshi Raman &Sangeeta Sharma, "*Technical Communication*", Oxford University Press, 2nd Edition, 2011.

Reference Books:

[1] S.P. Dhanavel, "*English and Soft Skills*", Orient Blackswan, 2010.

[2] R.S. Aggarwal, "*A Modern Approach to Verbal & Non-Verbal Reasoning*", S. Chand & Company Ltd., 2018.

[3] Dr.ShaliniVerma, "*Body Language*", S. Chand Publishers, 1st Edition, 2013.

E-resources and other digital material:

[1] www.Indiabix.com

[2] www.freshersworld.com

20EE5607-INTRODUCTION TO DATA STRUCTURES

Course Category:	**Program core**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Microcontrollers (20EE5301)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Apply** linear data structures to different applications.
CO2	**Solve** problems using linked list.
CO3	**Implement** operations on different tree and heap data structures.
CO4	**Apply** sorting algorithms to arrange a set of data items

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	**2**	**3**											
CO2	2	**2**	**3**											
CO3	2	**2**	**3**											
CO4	2	**2**	**3**											

Course Content

Task 1: Operations on a stack data structure.
Task 2 & 3: Stack applications (expression conversion and evaluation, Tower of Hanoi problem)
Task 4: Operations on queues and circular queues.
Task 5: Operations on singly linked list and doubly linked list.
Task 6: Operation on circular linked list and circular doubly linked list.
Task 7: Linked list applications: polynomial addition and multiplications.
Task 8: Binary search tree operations and tree traversal techniques using recursion.
Task 9: Binary search tree traversal techniques using non recursion
Task 10: Operations on threaded binary trees and priority Queues
Task 11: Sorting techniques: Merge sort, quick sort, and radix sort
Task 12: Sorting techniques: Heap sort, shell sort, and tree sort.

NOTE: A minimum experiments of **TEN** are to be conducted.

Text Books:

[1] Horowitz Sahni and Anderson-Freed "*Fundamentals of Data Structures in C*", 2nd

Edition, Universities Press, 2008.
[2] Reema Thareja, "*Data Structures using C*", 2nd Edition, Oxford University Press, 2011.

REFERENCE BOOKS

[1] Richard F. Gilberg & B. A. Forouzan *"Data Structures A Pseudocode Approach with C"*, 2nd Edition, Cengage Learning.
[2] Mark Allen Weiss*,"Data structure and Algorithm Analysis in C".* Addison Wesley Publication. 2006.
[3] Jean Paul Trembley & Paul G. Sorenson, *"An Introduction to Data Structures with Applications"*, McGraw Hill, 1984.
[4] Thomas Cormen, C.Leiserson, R. L.Rivest & C.Stein, *"Introduction to Algorithms"* 3rd Edition, MIT Press, 2009

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Dr. P. P. Chakraborty, IIT Kharagpur, May 19, 2010, Data Structures, NPTEL, Available: www.youtube.com/watch? v=S47aSEqm_0I
[2] Dr. Naveen Garg, IIT Delhi, Sep 24, 2008, Data Strucutres, NPTEL, Available: http://nptel.iitm.ac.in, http://freevideolectures.com/Course/2279/DataStructures-And-Algorithms
[3] Shai Simonson, Jun 16, 2014, Data Structures, NPTEL, Available: http://nptel.ac.in/video.php?-subjectId=106102064

20MC5108B - INNOVATION, IPR AND ENTREPRENEURSHIP

Course Category:	**Mandatory Course**	**Credits:**	0
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Prerequisites:	-	**Continuous Evaluation:**	100M
		Semester End Evaluation:	-
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Learn** the innovation concepts related to business organizations.
CO2	**Understand** the importance of innovation in new start-ups.
CO3	**Know** fundamental aspects of Intellectual property Rights.
CO4	**Learn** the basic concepts of entrepreneurship and its benefits.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		**1**						**2**	**2**		**2**			
CO2		**2**						**1**	**2**		**2**			
CO3		**2**						**2**	**3**		**3**			
CO4		**1**						**3**	**2**		**2**			

Course Content

UNIT-I **[Text Book-1]**

Innovation Management: Introduction**,** Innovation- definition, importance-the need to view innovation in an organizational context , different types of innovation-innovation and invention-popular views of innovation- innovation as a management process.

UNIT-II **[Text Book-1]**

Innovation-New Product Development (NPD): Innovation management and new product development-considerations when developing as NPD strategy-NPD as a strategy for growth- what is new product?-classification of new products- NPD as an industry innovation cycle**.**

UNIT-III **[Text Book-1]**

Intellectual Property Rights (IPR): Introduction and the need for intellectual property right (IPR)-kinds of intellectual property rights- patent, copyright, trade mark, design, geographical indication, plant varieties and layout design-genetic resources and traditional knowledge-trade secret- IPR in India- genesis and development**.**

UNIT-IV **[Text Book-2]**

Entrepreneurship: Concept and need of entrepreneurship -characteristics and types of entrepreneurship - entrepreneurship as a career - entrepreneurship as a style of management - the changing role of the entrepreneur - entrepreneurial traits, factors affecting entrepreneurs**.**

Text Books:

[1] Paul Trott , " *Innovation Management and New Product Development* ", Pearson Education Limited, UK, 2017.
[2] Nithyananda, K V., "*Intellectual Property Rights: Protection and Management",* Cengage Learning India Private Limited, 2019.
[3] Dr.S S Khanka, "*Entrepreneurial Development*", S Chand, New Delhi, 2020.

Reference Books:

[1] Joe Tidd, John Besant ,"*Managing innovation, Integrating Technological, Market and Organizational Change*", 2018.
[2] Neeraj, P., & Khusdeep, D, "*Intellectual Property Rights*". PHI learning Private Limited, India, 2019.
[3] Vasant Desai, "*The Dynamics of Entrepreneurial Development and Management*", Himalaya Publishing House, India, 2022.

E-resources and other digital material:

https://edisciplinas.usp.br/pluginfile.php/5553082/mod_folder/content/0/Trott%20-%202017%20-%20%20roz%20Innovation-Management-and-New-Product-Development.pdf?forcedownload=1

SEMESTER VI CONTACT HOURS: 29

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE6301	Program Core	Power System Analysis	2	0	2	3
2	20EE6302	Program Core	Power System Protection	3	0	0	3
3	20HS6103	Humanities and Social Sciences	Engineering Economics and Management	2	0	0	2
4	20EE6404	Program Elective 2	A. Utilization of Electrical Energy B. Programmable Logic Controller C. HVDC and FACTS D. Digital Signal Processing	3	0	0	3
5	20EE6205	Open Elective-2/ Job oriented elective-2	A. Machine Learning using Python B. Electric Vehicles	3	0	0	3
6	20EE6351	Program Core Lab 1	Power Systems Lab	0	0	3	1.5
7	20EE6352	Program Core Lab 2	Simulation of Electrical Systems Lab	0	0	3	1.5
8	20HS6153	Humanities & Social Science	Advanced Communication Skills Lab	0	0	2	1
9	20TP6106	**Soft Skills –4**	Quantitative Aptitude	0	0	2	1
10	20EE6554	Internship / Project	Mini Project - I	0	0	2	1
11	20MC6107B	Mandatory Course (AICTE suggested)	Biology for Engineers	2	0	0	0
Total				**15**	**0**	**14**	**20**
Industrial/Research Internship six weeks (Mandatory) during summer vacation							
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0)				**4**	**0**	**0**	**4**

Category	Credits
Program Core Courses	9
Humanities and Social Sciences	3
Program Elective Courses	3
Open Elective Courses	3
Skill Oriented courses	1
Mandatory Course	0
Internship / Project	1
TOTAL CREDITS	**20**

20EE6301-POWER SYSTEM ANALYSIS

Course Category:	**Program Core**	**Credits:**	3
Course Type:	Theory/Practical	**Lecture-Tutorial-Practice:**	2-0-2
Prerequisites:	Power Generation and Transmission (20EE5303)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Apply** the concept of per unit system and symmetrical components of inter-connected power system.
CO2	**Perform** power flow analysis using iterative techniques.
CO3	**Analyze** symmetrical and unsymmetrical faults of power system.
CO4	**Analyze** steady state and transient stability phenomena in power system.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			2						2			3	
CO2	3	3		3		3				2			3	
CO3	3	3		3		3				2			3	
CO4	3	3		3		2				2			3	

Course Content

UNIT-I [Text Book-1]

Representation of Power System Components: Introduction, single phase representation of balance three phase networks, representation of power system components, the one-line diagram and the impedance or reactance diagram, per unit system, complex power.

Symmetrical Components: Introduction, symmetrical component transformation, power invariance, sequence impedances and networks of power system, sequence impedances and networks of synchronous machine, sequence impedances and networks of transmission line, sequence impedances and networks of transformer, construction of sequence networks of a power system.

UNIT-II **[Text Book-1]**

Load Flow Studies: **Introduction, classification of buses, network model formation, load flow problem**

UNIT-III **[Text Book-1]**

Symmetrical Fault Analysis: Introduction, Transient on a transmission line, short circuit

of a synchronous machine (on no load), Short circuit of a loaded synchronous machine, short circuit (SC) current computation through the Thevenin's theorem.

Unsymmetrical Fault Analysis: Introduction Symmetrical component analysis of unsymmetrical faults, single line to ground fault, line-to-line fault, double line-to-ground fault.

UNIT-IV **[Text Book-2]**

Power System Stability: Introduction, classification of power system stability, dynamics of a synchronous machine, power angle equation, steady state stability, transient stability, equal area criterion, numerical solution of swing equation, factors affecting transient stability, methods of improving stability.

List of Laboratory Experiments:

1. Representation of per unit quantities of impedance diagram.
2. Transformation of phase components into symmetrical components for unbalanced networks.
3. Transformation of symmetrical components into phase components for different systems.
4. Formation of [Ybus] matrix using direct inspection method.
5. Load flow studies using GS method.
6. Load flow studies using NR/FDLF methods.
7. Symmetrical fault studies.
8. Unsymmetrical fault analysis.
9. Short circuit studies.
10. Transient and small signal stability analysis: Single-machine infinite bus system
11. Solution of the swing equation using step by step method
12. Determination of power angle curve for non- salient pole synchronous machines

Note: Minimum of two experiments has to be performed from each unit and total **eight experiments** are to be conducted in this course as a part of lab.

Text Books:

[1] D.P.Kothari and I.J.Nagrath, "Modern Power System Analysis", Tata Mc.Graw Hill, 4th edition, 2011.
[2] W.D.Stevenson.Jr, "Elements of Power System Analysis", Mc.Graw Hill, Indian Edition, 2017.

Reference Books:

[1] A.Hussain, "*Electrical Power Systems*", CBS Publishers and Distributors, 5th edition, 2010.
[2] T.K.Nagsarkar, M.S.Sukhija, "*Power System Analysis*", Oxford university press, 2007.

E-resources and other digital material

http://freevideolectures.com/Course/2353/Power-Systems-Analysis

20EE6302-POWER SYSTEM PROTECTION

Course Category:	**Program core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the basic concepts of protective system and working principles of relays.
CO2	**Understand** the working principle of different advanced protective relays
CO3	**Analyze** the concept and working principle of various types of circuit breakers
CO4	**Understand** the phenomena of generation of over-voltages and protective system

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						**2**							**3**	
CO2						**2**							**3**	
CO3	**2**					**2**							**3**	
CO4	**2**					**2**						**3**	**3**	

Course Content

UNIT-I **[Text Book-1]**

Introduction: Need for protective systems, Nature and causes of faults, types of faults, effects of faults, zones of protection, primary and back-up protection, essential qualities of protection, classification of protective relays, components of a protection system, classification of protective schemes, automatic reclosing.

Relays: Introduction, electromechanical relays, time-current characteristics, current setting, time setting, over-current protective schemes, reverse power of directional relay, Impedance relay- operating principle, characteristics, electromechanical impedance relay; electromechanical reactance & Mho relay, differential relays- Simple differential, percentage differential, balanced voltage differential protection.

UNIT-II **[Text Book-1]**

Static Relays: Merits and demerits of static relays, comparators, duality, static over-current relays: instantaneous, definite time, inverse time, directional, Static impedance, reactance and Mho relays using an amplitude comparator**.**

Microprocessor Based Numerical Protective Relay: Introduction, over-current relays, impedance relay, directional relay, reactance relay, generalized mathematical expression for distance relays, measurement of R and X, Mho and offset mho relays, quadrilateral relay, generalized interface for distance relays.

Numerical Relays: Numerical relay, advantages and disadvantages of numerical relays, Numerical over current, distance, differential protection.

UNIT-III **[Text Book-1]**

Circuit Breakers: Introduction, fault clearing time of a circuit breaker, arc voltage, arc interruption, re-striking voltage and recovery voltage, resistance switching, current chopping, classification of circuit breakers, air break circuit breakers, oil circuit breakers, air blast circuit breakers, SF_6 circuit breakers, vacuum circuit breakers, rating of circuit breakers, testing of circuit breakers.

Fuses: Fuse characteristics, types of fuses, applications of HRC fuses, selection of fuses, discrimination.

UNIT-IV **[Text Books-1&2]**

Protection Against Over Voltages: Causes of over-voltages, lighting phenomena, wave shape of voltage due to lightning, over-voltages due to lightning, protection of transmission lines against direct lighting strokes, protection of stations and sub stations from direct strokes, protection against waves.

Grounding: Neutral grounding, solid grounding, resistance grounding, reactance grounding, resonant grounding, voltage transformer grounding, grounding through grounding transformer, equipment grounding.

Text Books:

[1] J.B.Gupta, "*Switch gear and Protection*", S.K Kataria and Sons, 2nd Edition, 2004.

[2] B.Ram, D.N.Viswakarma, "*Power System Protection and Switch gear*", Tata Mc. Graw Hill, 4th Edition, 2011.

Reference Book:

[1] S.S.Rao, "*Switch gear and Protection*", Khanna Publishers New Delhi, Latest Edition.Year

E-resources and other digital material

https://www.nptel.ac.in/courses/108101039

20HS6103 - ENGINEERING ECONOMICS AND MANAGEMENT

Course Category:	**Humanities & Social Science**	**Credits:**	2
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Understand** various forms of organizations and principles of management.
CO2	**Understand** the various aspects of business economics.
CO3	**Acquire** the knowledge on human resources and marketing functions.
CO4	**Evaluate** various alternatives economically.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**										**2**			
CO2	**2**	**3**									**2**			
CO3	**2**										**2**			
CO4	**2**	**3**									**2**			

Course Content

UNIT-I **[Text Book-1&2]**

Forms of Business Organization: salient features of sole proprietorship, partnership, joint stock company, private limited and public limited companies, co-operative society and public sector.

Management: Introduction to management, functions of management, principles of scientific management, modern principles of management.

UNIT-II **[Text Book-1&2]**

Introduction to Economics: Introduction to basic economic concepts, utility analysis, marginal utility and total utility, law of diminishing marginal utility, law of equi-marginal utility.

Demand Analysis: Theory of demand, demand function, factors influencing demand, demand schedule and demand curve, shift in demand, elasticity of demand, elastic and inelastic demand, types of elasticity.

Supply Analysis: Supply schedule and supply curve, factors influencing supply, supply function. factors of production, production function, production with one variable input, iso-quants, returns to scale, cost function: cost-output relationship in short run and long

run, relationship between AC and MC. Supply analysis, supply schedule and supply curve, factors influencing supply, supply function, theory of firm: price determination under equilibrium of firm, perfect competition.

National Income, Money and Banking, Economic Environment:
National income concepts, GNP, NNP, methods of measuring national income, inflation, deflation, kinds of money, value of money, functions of bank, types of bank, economic liberalization, privatization, globalization.

UNIT-III **[Text Book –1&2]**

Human Resource Management: Meaning and difference between personnel management and human resource management, functions of human resource management.

Marketing Management: Concept of selling and marketing, differences, functions of marketing, product life cycle, concept of advertising, sales promotion, types of distribution channels, marketing research, break, even analysis, problems.

UNIT-IV **[Text Book-1&2]**

Financial management: Functions of financial management, time value of money with cash flow diagrams, concept of simple and compound interest.

Depreciation: causes of depreciation, factors influencing depreciation, common methods of depreciation: straight line method, declining balance method, sum of year's digits method, problems.

Economic Alternatives: Methods of evaluating alternatives under present worth method, future worth method, annual equivalent method - problems

Text Books:

[1] M. Mahajan "*Industrial Engineering and Production Management*", Dhanpat Rai Publications, 2nd Edition, 2015
[2] Martand Telsang "*Industrial & Business Management"* S.Chand publications 2001

Reference Books:

[1] Philip Kotler &Gary Armstrong "*Principles of Marketing*", PHI, New Delhi, 2012.
[2] B.B Mahapatro, **"***Human Resource Management*", New Age International, 2011.
[3] IM Pandey, "*Financial Management*" Vikas Publications 11th Edition
[4] R. Panneerselvam, "*Production and operations management*", PHI, New Delhi, 2012.

E-resources and other digital material:

[1] https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/
[2] https://keydifferences.com/difference-between-personnel-management-and-human-resource-management.html
[3] http://productlifecyclestages.com/
[4] https://speechfoodie.com/cash-flow-diagrams/

20EE6404A-UTILIZATION OF ELECTRICAL ENERGY

Course Category:	**Program Elective-2**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Electrical Machines-I (20EE3303)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Illustrate** the concepts of electric traction and braking methods.
CO2	**Demonstrate** the concepts of electric heating, welding and design of heating element.
CO3	**Explain** the construction and working principle of different types of lights, designing of lightning system.
CO4	**Demonstrate** the concepts of refrigeration and air conditioning.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**				**2**		**2**						**3**	
CO2	**3**		**3**		**2**		**3**						**3**	
CO3	**3**		**3**		**2**		**3**						**3**	
CO4	**2**				**2**		**2**						**3**	

Course Content

UNIT-I **[Text Book-1]**

Electric Traction: System of traction, system of electric traction, speed-time curves for train movement- approximate values of acceleration and retardation, simplified speed time curves; mechanics of train movement-tractive effort for acceleration, tractive effort for propelling a train, power output from the driving axles, energy output from driving axles, determination of specific energy output on level track using a simplified speed time curve, factors which affect specific energy consumption; train resistance, adhesive weight, co-efficient of adhesion, control of DC motors: series-parallel starting, the series-parallel control, drum controller; electric braking- plugging, rheostatic and regenerative braking.

UNIT-II **[Text Book-1]**

Electric Heating: Electrical heating, resistance ovens - design of resistance heating elements, losses in oven and efficiency, applications of resistance furnaces, convection type furnaces, control equipment for resistance ovens; radiant heating, induction heating - core-type, vertical core type furnace Ajax Wyatt furnace, coreless induction furnace; high frequency eddy current heating- important features of high frequency eddy current

heating, applications, high frequency power supply sources; dielectric heating -electrical problems in dielectric heating, applications; arc furnaces -some aspects of arc furnaces.

Welding: Electrical welding-resistance welding, machines for resistance welding, arc welding, electric arc welding equipment, modern welding techniques- ultra-sonic welding.

UNIT-III **[Text Book-1]**

Illumination: Definitions, laws of illumination, polar curves -Rousseau's construction, Electrical Lamps-filament lamps, arc lamps, electric discharge lamps, CFL, LED lighting, LED drivers, lighting fittings- symmetrical Fittings, asymmetrical Fittings, illumination for different purposes-factory lighting, flood-lighting, street lighting, requirements of good lighting.

UNIT-IV **[Text Book-1]**

Refrigeration: Refrigeration cycle, refrigeration system-vapour compression refrigeration system, vapour absorption refrigeration system, thermo-electric refrigeration system, types of refrigerants, domestic refrigerator.

Air-Conditioning: Introduction to air conditioning, comfort air conditioning, industrial air conditioning, effective temperature, types of air conditioning, room air conditioners, central air conditioning systems.

Text Books:

[1] A.Chakrabarti, M.L. Soni, P.V.Gupta, U.S.Bhatnagar, "*A Textbook on Power System Engineering*" Dhanpat Rai & Co, (P) Ltd, 2nd Edition, 2018.

[2] J.B.Gupta, "*Utilization of Electric power and Electric Traction*", S.K.Kataria & sons, 10th Edition, 2013.

Reference Books:

[1] R.K.Rajput, "*Utilization of Electrical Power*", Laxmi Publications Pvt., Ltd., New Delhi, 5th Edition, 2006.

[2] H.Partab, "*Art and Science of Utilization of Electrical Energy*" Dhanpat Rai and Co. (P) Ltd, 3rd Edition, 2011.

[3] C.L.Wadhwa, "*Generation, distribution, and utilization of electrical energy*", Kent England: New Academic Science Limited, 3rd Edition, 2013.

E-resources and other digital material

[1] http://nptel.ac.in/courses/108105060/

20EE6404B–PROGRAMMABLE LOGIC CONTROLLER

Course Category:	**Program Elective-2**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Microcontrollers (20EE5301)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the PLC internal architecture and ladder logic concepts.
CO2	**Apply** the concept of register, timer, counter, and other intermediate programming.
CO3	**Apply** the concept of data handling functions.
CO4	**Control** the robot using PLC and **Extend** knowledge of PLC in analog operations.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**	**1**	**2**	**3**	**3**			**1**			**2**		**3**
CO2	**3**	**3**	**2**	**2**	**3**	**3**			**3**			**2**		**3**
CO3	**3**	**3**	**2**	**2**	**3**	**3**			**3**		**1**	**2**		**3**
CO4	**3**	**3**	**2**	**2**	**3**	**3**			**3**			**2**		**3**

Course Content

UNIT-I **[Text Book-1]**

PLC Basics: PLC advantages and disadvantages, overall PLC System, PLC input and output modules, I/O modules interfaces, programming equipment, programming formats, proper construction of PLC ladder diagrams, input/ output ON/OFF switching devices, input/ output analog devices.

PLC Programming: PLC input instructions, outputs, operational procedures, contacts and coils I/O programming examples, industrial process example (drill press operation), digital logic gates, boolean algebra PLC programming, conversion examples, ladder diagrams and sequence listings, large-process ladder diagram construction, flowcharting as a programming method .

UNIT-II **[Text Book-1]**

PLC Registers: General characteristics of Registers, module addressing, holding registers, input registers, output registers, PLC Timer functions, examples of timer function industrial applications, industrial process timing application (Heat/ Quench station); PLC counters, examples of counter function industrial applications, architecture functions, PLC addition and subtraction, the PLC repetitive clock, PLC multiplication, division and square root, PLC basic comparison functions, PLC basic comparison

functions applications, PLC conversions between decimal and BCD.

UNIT-III **[Text Book-1]**

Data Handling Functions: SKIP function and applications, master control relay function and applications, Jump with non-return, jump with return, PLC move function and applications, moving large blocks of PLC data, PLC table and register moves, FIFO function, FAL function, ONS, CLR and Sweep functions.

UNIT-IV **[Text Book-1]**

PLC Functions Working with Bits: Bit Pattern in a register, changing a register bit status, shift register functions, shift register applications, Electromechanical sequencing, Basic PLC sequencer function, basic PLC sequencer application with timing, Basic two axes Robot with PLC sequencer control, PLC and AND/OR matrix functions, PLC complement and compare matrix functions, combination PLC matrix operations.

Analog PLC Operation: Types of analog modules and systems, analog signal processing, BCD or multi-bit data processing, PLC analog output application examples. PID principles, typical continuous process control curves, PID modules, PID tuning, typical PID functions.

Text Books:

[1] John W Webb and Ronald A Reiss, "*Programmable Logic Controllers: Principle and Applications*", PHI, 5th Edition, 2009

[2] JR Hackworth and ED Hackworth, "*Programmable Logic Controllers: Programming Method and Applications*", Prentice Hall, 2004.

Reference Book:

[1] Max Rabiee, "*Programmable Logic Controllers: Hardware and Programming*", Goodheart-Willcox Publisher, 2009

E-resources and other digital material:

[1] https://nptel.ac.in/courses/112102011/11

20EE6404C-HVDC & FACTS

Course Category:	**Program Elective-2**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Power Electronics (20EE5302)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Summarize** different types of HVDC Transmission systems and **Analyze** power converter circuits.
CO2	**Examine** control schemes of HVDC transmission systems.
CO3	**Classify** different types of FACTS devices and their applications in compensation of reactive power.
CO4	**Analyze** static series and combined compensators.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2						3						
CO2	3	2						3	2					2
CO3	3	2						3	2					2
CO4	3	2						3	2					2

Course Content

UNIT- I **[Text Book-1]**

Introduction: Comparison of AC-DC transmission systems, application of DC transmission, types of DC links, typical layout of HVDC converter station. HVDC converters, pulse number, analysis of Graetz circuit with and without overlap, converter bridge characteristics, and equivalent circuit of rectifier and inverter configurations of twelve pulse converters. Reactive power requirements, AC & DC side filters.

UNIT-II **[Text Book-1]**

HVDC System Control: Principles of DC Link control, converter control characteristics, system control hierarchy, firing angle control, current and extinction angle control, energization and de-energization of DC Link.

UNIT-III **[Text Book-2]**

Introduction to FACTS: Power flow in AC Parallel paths and meshed systems, basic types of FACTS controllers, brief description and definition of FACTS controllers. Static shunt compensators-objectives of shunt compensation, methods of controllable VAR

generation, static VAR compensators, SVC and STATCOM, comparison between SVC and STATCOM.

UNIT-IV **[Text Book-2]**

Static Series Compensators: Objectives of series compensation, variable impedance type and thyristors switched series capacitors (TCSC), and switching converter type series compensators, static series synchronous compensator (SSSC), power angle characteristics, basic operating control schemes**.**

Combined Compensators: Introduction, unified power flow controller (UPFC), basic operating principle, independent real and reactive power flow controller, control structure.

Text Books:

[1] S.Kamakshaiah, V.Kamaraju, "*HVDC Transmission systems*", Mc Graw Hill Companies, 2nd edition, 2011.

[2] N.G.Hingorani, L.Gyugyi," *Understanding FACTS, Concepts and Technology of Flexible AC Transmission systems*", IEEE press,John Wiley and Sons India, 2nd edition, 2001.

Reference Books:

[1] K.R.Padiyar, "*HVDC Power transmission systems*",New Age International, 2nd edition, 2011.

[2] R.M.Mathur, R.K.Varma, "Thyristor *Based Controllers for Electrical Transmission Systems"*Wiley India, 1st edition, 2002.

[3] V.K.Sood, "*HVDC and FACTS Controllers applications of static Converters in power systems*", Springer-Verlag New York, 2013.

E-resources and other digital material

[1] http://kluweronline.com/

[2] https://nptel.ac.in/courses/108104013/

[3] https://nptel.ac.in/courses/108107114/

20EE6404D - DIGITAL SIGNAL PROCESSING

Course Category:	**Program Elective-2**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Transformations and Numerical Methods (20BS3101)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Identify** and categorize discrete time systems.
CO2	**Analyze** discrete systems using Z transforms.
CO3	**Apply** DFT to discrete systems and evaluate DFT using fast Fourier and transforms.
CO4	**Design** FIR and IIR filters and realize digital filters.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3								3				3
CO2	3									3				3
CO3	3	3								3				3
CO4	3	3								3				3

Course Content

UNIT-I **[Text Book-1]**

Discrete Signals and Systems: Introduction to digital signal processing, advantages and applications, discrete time signals, LTI system: stability and causality, frequency domain representation of discrete time signals and systems.

Z-Transforms: Z-transforms, Region of convergence, Z-transform theorems and properties, Relation between Z-transform and Fourier transform of a sequence, Inverse Z-transform using Cauchy's integration theorem, Partial fraction method, Long division method, Solution of difference equations using one sided Z-transform, Frequency response of a stable system.

UNIT-II **[Text Book-2]**

DFT and FFT: Discrete Fourier series, properties of DFS, discrete Fourier transform, properties of DFT, linear convolution using DFT, computations for evaluating DFT, decimation in time FFT algorithms, decimation in frequency FFT algorithm, computation of inverse DFT.

UNIT-III **[Text Book-2]**

IIR Filter Design Techniques: Introduction, properties of IIR filters, IIR filter design using bilinear transformation and impulse Invariance methods, design of digital Butterworth and Chebyshev filters using bilinear transformation, impulse invariance transformation methods, and design of digital filters using frequency transformation method.

UNIT-IV **[Text Book-2]**

FIR Filter Design Techniques: Introduction to characteristics of linear phase FIR filters, frequency response, designing FIR filters using windowing methods, rectangular window, hanning window, hamming window, generalized hamming window, bartlett triangular window, comparison of IIR and FIR filters.

Realization of Digital Filters: Direct, canonic, cascade, transposed, parallel and ladder realizations.

Text Books:

[1] Alan V Oppenheim and Ronald W Schafer, "*Digital Signal Processing"* PHI, 2004.

[2] Proakis, J. Gard and D. G. Manolakis, "*Digital Signal Processing: Principals, Algorithms and applications*", 3rd Edition, PHI, 2003.

Reference Books:

[1] M.H.Hayes, "*Digital Signal Processing*", TMH, 2009.

[2] P.Ramesh Babu, "*Digital Signal Processing*", Scitech Publications, 2nd Edition, 2004.

[3] S K Mitra, "*Digital Signal Processing: A Computer Based Approach*", Tata Mc. Graw Hill Publication, 2nd Edition, 2003

[4] S.Salivahanan ,"*Digital Signal Processing",* TMH, 2000.

E-resources and other digital material

[1] www.dsptutor.freeuk.com

[2] https://nptel.iitm.ac.in/courses/Webcourse contents/ IITKANPUR/ Digi_Sign_Pro/ui/ About-Faculty.html

20EE6205A MACHINE LEARNING USING PYTHON

Course Category:	**Open Elective-II**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	20ES2103B - Python Programming	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	Understand the concepts of python programming and descriptive analytics.
CO2	Understand the concepts of probability distributions and hypothesis tests
CO3	Understand the concepts of linear regression
CO4	Classify the problems

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				**2**	**3**									
CO2	**3**			**2**										
CO3	**3**			**2**										
CO4	**2**			**2**										

Course Content

UNIT-I **[Text Book-1]**

Introduction to Machine Learning: Review of Python**,** descriptive analytics-working with data frames in Python, handling missing values, exploration of data using visualization.

UNIT-II **[Text Book-1]**

Probability Distributions and Hypothesis Tests: Overview, probability theory – terminology, random variables, binomial distribution, Poisson distribution, exponential distribution, normal distribution, other important distributions, central limit theorem, hypothesis test, Analysis of Variance (ANOVA).

UNIT-III **[Text Book-1]**

Linear Regression: Simple linear regression, steps in building a regression model, building simple linear regression model, model diagnostics, multiple linear regression.

UNIT-IV **[Text Book-1]**

Classification Problems: Classification Overview, binary logistic regression, credit

classification, gain chart and lift chart, classification tree (decision tree learning).

Text Books:

[1] Manaranjan Pradhan, U Dinesh Kumar, "*Machine Learning using Python*", Wiley Publication, 1st Edition, 2019.

Reference Books:

[1] Andreas C. Müller, Sarah Guido, "*Introduction to Machine Learning with Python*", O'Reilly Media, 1st Edition, 2018.

[2] Wei-Meng Lee, *"Python Machine Learning"*, Wiley Publication, 1st Edition, 2019.

E-resources and other digital material

https://nptel.ac.in/courses/106105152

20EE6205B-ELECTRICAL VEHICLES

Course Category:	**Open Elective-II**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Chemistry (20BS1102) Electrical Machines-I & II (20EE3303& 20EE4303) Power Electronics (20EE5302)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the basics of electric and hybrid electric vehicles, their technologies, and fundamentals.
CO2	**Apply** different energy storage devices for electric vehicles, their technologies, and characterization
CO3	**Analyze** the use of different electrical machines and power electronics devices in electric vehicles.
CO4	**Analyze the** interfacing of EVs with Grid and business opportunities in the electric vehicle domain

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**		**2**		**1**							**1**		
CO2	**3**		**2**		**1**							**1**		
CO3	**3**		**2**		**1**							**1**		
CO4	**3**		**2**		**1**							**1**		

Course Content

UNIT-I **[Text Book-1]**

Introduction: Electric Vehicles**,** components of electric and hybrid vehicle, history of electric and hybrid vehicle, hybrid electric vehicle-series and parallel hybrids, series-parallel hybrid, plug-in hybrid electric vehicle, basics of Fuel Cell Vehicles (FCVs).

UNIT-II **[Text Book-1]**

Batteries in Electric vehicles: Battery fundamentals, types of batteries, lithium-ion battery modeling-classification, electric circuit models, battery impedance model, lithium-ion battery parameters-battery capacity, open-circuit voltage, terminal voltage, State of Charge (SOC), State of Health (SOH), role of battery management system

(BMS) in battery pack, super-capacitor, super-capacitor characterization, fuel cells, types of fuel cell.

UNIT-III **[Text Book-1]**

Electric vehicle propulsion unit: Overview on electric vehicle propulsion unit, Induction machines-simplified torque expression, regenerative braking, permanent magnet brushless direct current- motor fundamentals and modeling, DC/DC converters-buck converter, boost converter, buck-boost converter.

UNIT-IV **[Text Book-1 & 2]**

Electric Vehicle and Power grid : Vehicle grid interface-grid to vehicle (G2V) and its challenges, vehicle to grid (V2G) and its challenges, electric vehicle charging profile-constant current (CC), constant voltage (CV), constant current and constant voltage (CCCV), electric vehicle charging levels, DC fast charging, components of EV charging station. e-mobility business opportunities-battery swapping, battery recycling, charging stations, battery packs, e-mobility Indian roadmap perspective.

Text Books:

[2] I.Hussein, "*Electric and Hybrid Vehicles: Design Fundamentals*", CRC Press, 2003.

[3] Tariq Muneer and Irene Illescas García, "*The Automobile in Electric Vehicles: Prospects and Challenges*", Elsevier, 2017.

Reference Books:

[1] M.Ehsani, Y.Gao, E.S.Gay, A.Emadi, "*Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*", CRC Press, 2004

[2] D.C.Hanselman, *"Brushless Permanent Magnet Motor Design"*, Magna Physics Publications, 2006.

E-resources and other digital material

https://nptel.ac.in/courses/108106170

20EE6351-POWER SYSTEMS LAB

Course Category:	**Program core lab**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Power Generation and Transmission, Power system protection (20EE5303&20EE6302)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze** and present experiment results.
CO3	**Exhibit** Professional behaviour.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**		**3**	**1**	**1**						**3**		**2**	**3**
CO2			**3**							**3**	**3**		**2**	
CO3			**3**							**3**				

LIST OF EXPERIMENTS.

1. Performance of transmission line model
2. Characteristics of electromagnetic relays
3. Characteristics of static relays
4. Characteristics of microprocessor based relays
5. a. Communication of numerical relay with PC
   b. Configuration of numerical relay for over current and over voltage protection
6. Relay coordination and Three phase fault simulation on transmission line model
7. Active and Reactive power control of single machine connected infinite bus.
8. Obtain sequence reactance's of alternator
9. Obtain sequence reactance of transformer and voltage control using tap changing transformer
10. High voltage testing of insulators and cables
11. Load flow analysis and fault studies using AC network analyzer
12. Study of Buchholz relay, thermo-magnetic over current relay operated air circuit breaker
13. 3-Zone protection of transmission line using Numerical distance relay
14. Differential protection of Transformer using numerical relay

NOTE: Minimum of 10 experiments are to be completed

20EE6352-SIMULATION OF ELECTRICAL SYSTEMS LAB

Course Category:	**Program core lab**	**Credits:**	1.5
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Electrical Machines-I& II (20EE3303 &20EE4303) Linear Control Systems (20EE4302)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze** and present experiment results.
CO3	**Exhibit** Professional behaviour.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				**2**					**3**		**3**		**2**	**1**
CO2									**3**	**3**	**3**		**2**	
CO3									**3**	**2**	**3**			

Course Content

LIST OF EXPERIMENTS:

1. Modelling of transmission lines.
2. Simulation of three phase rectifier with R, R-L and R-L-E loads.
3. Simulation of three-phase inverter.
4. Speed control of three phase induction machine.
5. Transient analysis of electrical system.
6. Fault analysis of a simple power system.
7. Simulation of 3-phase power system network for different loads.
8. Economic dispatch with and without losses.
9. Simulation of single area load frequency control.
10. Load flow studies.
11. Voltage stability analysis.
12. Modelling of over current relay.
13. Short circuit analysis.
14. Transient Stability analysis of SMIB.

NOTE: A minimum of 10 experiments are to be completed.

20HS6153-ADVANCED COMMUNICATION SKILLS LAB

Course Category:	**Humanities & Social Science**	**Credits:**	1
Course Type:	Practice	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	20HS2153- Technical English and Communication Skills Lab	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Apply** elements of listening comprehension relevant for professional environments
CO2	**Apply** rational spoken communication with authentic accentuation in connected speech complemented by the abilities of argumentation and skills of public speaking.
CO3	**Understand** the nuances of requisite advanced reading skills for transnational techno-professional communication.
CO4	**Produce** higher order written communication required for administrative and corporate compilations

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3				
CO2						1		1	2	3	2	2		
CO3								1	2	3	2			
CO4				1		1			2	3	2	1		

Course Content

UNIT-I

TED Talks:

Listening involving 5R Method

Elevator Pitch:

Pitches for technical audience and administrators- exposure through soft components and illustrations

UNIT-II

Advanced Spoken Communication Skills:

Interpersonal communication -Individual and Group - Pyramid discussion- Conceptual framework and practice.

Dynamics of technical and professional presentations- Illustrations and Practice including paralinguistic elements

UNIT-III

Advanced Reading and interpretation skills:

Effective reading- SQ3R Method, ERRQ Method and SPE Method with textual practice

Logical reading- Syllogisms -illustrations and practice.

UNIT-IV

Advanced Writing and other professional communication skills :

Advanced compilation and drafting skills-Minuets, Résumé & Video profile, review and case writing

Life skills for work place communication- including sensitivity towards gender and diversity in communication- Multi-genre Activity .

Text Book(s):

[1] Lokesh Mehra, Sanjiva Dubey, S. P. Singh "*Corporate Employability Skills",* 1st Edition, CEGR, New Delhi, 2016.

[2] Brent C. Oberg.C, "*Interpersonal Communication"*, 1st Impression, Jaico Publishing, Mumbai, 2005.

[3] Eclectic materials offered by the Department of English

Reference Books:

[1] Chauhan, Gajendra Singh, Smitha Kashiramka, "*Technical Communication",* Cengage , Delhi, 1st Impression ,2018

[2] Quintanilla Kelly M , Shan T Wahl, " *Business and Professional Communication: Keys for Workplace Excellence*", SAGE , New Delhi, 2nd Impression 2012

[3] Selinkar, Larry et al, English for Academic and Technical Purposes, 1st Edition, Newbury House Publishers, 1981.

[4] John Langan, "*College Writing Skills"*, McGraw Hill, IX Edition, 2014

[5] Martin Cutts, "*Oxford Guide to Plain English"*, 7th Impression, OUP, 2011

E-resources and other digital material

[1] ODll Language Learner's Software, 27-6-2012 Orell Techno Systems.

[2] Visionet Spears Digital Language Lab software Advance Pro , 28-01-2015

[3] www.britishcouncil.org/learning-english-gateway.

[4] The-oxford-guide-to-english-usage-pdf.

[5] www.cambridgeapps.org/ .

20TP6106–QUANTITATIVE APTITUDE

Course Category:	**Soft skills-4**	**Credits:**	1
Course Type:	Learning by doing	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	--	**Continuous Evaluation:**	100M
		Semester End Evaluation:	--
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	Solve basic mathematics problems.
CO2	Apply strategies to simplify the problems.
CO3	Apply mathematical skills in solving analytical problems personal life.
CO4	Interpretation of data through graphs and charts.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**													
CO2		**2**												
CO3	**2**													
CO4				**2**										

Course Content

UNIT-I
Numerical ability I: Number system, HCF & LCM, average, simplification, problems on numbers.
Numerical ability II: Ratio & proportion, partnership, percentages, profit & loss.

UNIT-II
Arithmetical ability I: Problems on ages, time & work, pipes & cistern, chain rule.
Arithmetical ability II: Time & distance, problems on boats &steams, problems on trains.

UNIT-III
Arithmetical ability III: Allegation, simple interest and compound interest, races & games of skills, calendar and clock.
Logical ability: Permutations, combination and probability.

UNIT-IV
Mensuration: Geometry, areas, volumes,
Data interpretation: Tabulation, bar graphs, pie charts, line graphs

Text Book:

[1] R. S. Aggarwal, "*Quantitative Aptitude*", Revised, S Chand publication, 2017, ISBN: 8121924987.

20MC6107B-BIOLOGY FOR ENGINEERS

Course Category:	**Mandatory course**	**Credits:**	0
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Prerequisites:		**Continuous Evaluation:**	100M
		Semester End Evaluation:	-
		Total Marks:	100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	Describe the fundamental principles and methods of engineering.
CO2	Identify the functions of different types in bio-molecules.
CO3	Describe mechanisms underlying the working of molecular biological processes including enzyme catalysis, metabolic pathways, gene expression.
CO4	Use Excel, MATLAB and other computational tools to quantitatively analyze biological processes.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**3**												
CO2		**3**												
CO3		**2**		**3**										
CO4		**1**		**2**	**3**									

Course Content

UNIT-I **[Text Book-1]**

Introduction and Classification of Living organisms:

Introduction: Fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Biology as an independent scientific discipline. Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.

Classification: Classification of living organisms based on (a) Cellularity- Unicellular or multi-cellular (b) Ultra-structure- prokaryotes or eukaryotes. (c) Energy and Carbon utilization – Autotrophs, heterotrophs, lithotrophs (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitat- acquatic, terrestrial (f) Molecular taxonomy- three major kingdoms of life.

UNIT-II **[Text Book-1]**

Bio-molecules and Enzymes:

Bio-molecules: Structures of sugars (Glucose and Fructose), starch and cellulose. Nucleotides and DNA/RNA. Amino acids and lipids. Proteins- structure and functions- as enzymes, transporters, receptors and structural elements.

Enzymes: Enzyme classification. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters.

UNIT-III **[Text Book-1]**

Genetics and Genetic information Transfer:

Genetics:"Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele Concepts of recessiveness and dominance Gene interaction, Epistas is Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.

Genetic Information Transfer: DNA as a genetic material. Hierarchy of DNA structure-from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

UNIT-IV **[Text Book-1]**

Metabolism and Microbiology

Metabolism: Exothermic and endothermic versusendergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy.ATP as an energy currency. Breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions.

Microbiology: Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Growth kinetics. Ecological aspects of single celled organisms, Microscopy.

Text Books:

[1] Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. *"Biology: A global approach*" Pearson Education Ltd

[2] Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H.,*"Outlines of Biochemistry"*, John Wileyand Sons

[3] By Nelson, D. L.; and Cox, M. M.W.H. Freemanand Company "*Principles of Biochemistry"* (V Edition),

[4] Stent, G. S.; and Calender, R.W.H. Freeman andcompany, Distributed by Satish Kumar Jain "*Molecular Genetics*," Second edition, CBS Publisher)

[5] Prescott, L.M J.P. Harley and C.A. Klein "*Microbiology*" Wm, C.Brown Publishers, 2nd edition 1995

SEMESTER VII **CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE7301	Program Core	Power System Operation & Control	3	0	0	3
2	20EE7402	Program Elective- 3	A. Optimization Techniques B. Introduction to Smart Grid Technology C. Industrial Drives D. Advanced Power Electronics	3	0	0	3
3	20EE7403	Program Elective- 4	A. VLSI design	3	0	0	3
			B. Embedded Systems	3	0	0	
			C. Digital Design with FPGA	3	0	0	
			D. Digital Controllers Lab	1	0	4	
4	20EE7404	Program Elective -5	A. Electrical Distribution System	3	0	0	3
			B. High-Voltage Engineering	2	0	2	
			C. Power Quality	3	0	0	
	20EE7454D		D. PLC and SCADA Lab	1	0	4	
5	20EE7205	Open Elective /Job oriented elective -3	MOOCS course	3	0	0	3
6	20EE7206	Open Elective /Job oriented elective -4	MOOCS course	3	0	0	3
7	20EE7607	**Skill Advanced Course**	IOT Fundamental: Connecting Things (CISCO Certification)	1	0	2	2
8	20EE7551	Internship / Project	Mini Project - II	0	0	3	1.5
9	20EE7552	Internship / Project	Industrial/Research Internship 2 Months (Mandatory) after 3rd year (to be evaluated during VII Semester)	0	0	3	1.5
Total				**19/18/15**	**0**	**8/10/16**	**23**
Honors/Minor Courses (the hours distribution can be 4-0-0, 3-0-2, 3-1-0 also)				**4**	**0**	**0**	**4**

Note: Open Elective Courses 3 and 4 are self-learning. Students may opt from any MOOCs platform. They have to submit the certificate before the last instruction day of VII semester.

Category	Credits
Program Core	3
Program Electives	9
Open Electives	6
Skill Oriented Courses	2
Internship / Project	3
TOTAL CREDITS	**23**

20EE7301A-POWER SYSTEM OPERATION &CONTROL

Course Category:	**Program core**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Linear Control System(20EE4302)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Solve** economic load dispatch problem of thermal units.
CO2	**Model** LFC, AGC for a thermal power system.
CO3	**Model** AVR for an isolated thermal system. **Explain** methods of voltage control in transmission and distribution systems
CO4	**Understand** the functions of power system control centers and distribution automation using SCADA

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3				3				2			2	
CO2	3		3							3				3
CO3	2	2	3			3				3				3
CO4	1					3				2				3

Course Content

UNIT-I **[Text Book-1]**

Economic Operation of Power Systems: Economic dispatch in thermal power station-heat rate curves, cost curves, incremental fuel and production costs, economic distribution of load between units without consideration of line losses, transmission line losses as a function of plant generation, calculation of loss coefficients, optimum generation allocation between thermal plants, unit commitment, constraints and priority list method.

UNIT-II **[Text Book-1]**

Basic Power System Control Loops: Importance of keeping voltage and frequency constant in a power system. Load frequency control single area case, P-F loop, schematic of load frequency control and Q-V loop, AVR of a synchronous generator.

Load Frequency Control: Mathematical modeling of generator, loads, prime mover and speed governor for load frequency control and corresponding block diagram representation, load frequency control block diagram of an isolated power system, steady state analysis, dynamic response, automatic generation control (AGC) scheme, AGC in a single and two area systems and block diagram representation of AGC for an isolated

power system.

UNIT-III **[Text Book-1&2]**

Reactive Power Control in Synchronous Generators: Role of excitation system- exciter, generator and sensor models, simplified AVR block diagram, steady state response for a step change in terminal voltage.

Transmission Line Compensation: Series compensation, shunt compensation, static VAR compensators- Thyristor Controlled Reactors (TCR), Thyristor Switched Capacitors (TSC), combined TCR and TSC, schematic of all three types.

Voltage Control of Distribution Systems: Tap changing transformers, booster transformers, synchronous phase modifiers and static capacitors.

UNIT-IV **[Text Book-2&3]**

Power System Control Centers: Aim of control centers, functions of control centers-planning, monitoring and data acquisition and system control, setup, locations, central and civil facilities, and facilities in control room, communication-PLCC and emergency control.

Distribution Automation: Functions and operations-devices of distribution automation, flow diagram for man machine power system interface, schematic diagram of remote terminal unit, SCADA system-schematic diagram, components.

Text Books:

[1] H.Saadat, "*Power System Analysis*", Tata McGraw Hill, Latest edition.

[2] A.Chakrabarti and S.Halder, "*Power System Analysis Operation and Control*", Prentice Hall of India, 3rd edition, 2010.

[3] CL.Wadhwa, "*Generation Distribution and Utilization of Electrical Energy*", New Age International publications, 2nd edition, 2006.

Reference Books:

[1] D.P.Kothari and I.J.Nagrath, "*Modern Power System Analysis*", McGraw Hill, Latest edition.

[2] C. L. Wadhwa, "*ElectricalPower Systems*" New Age International Publishers, 6th edition, 2010.

[3] William D. Stevenson, Jr., "*Elements of Power System Analysis",* McGraw Hill, 4th edition

[4] Allen J. Wood, Bruce F. Wollenberg, "*Power Generation, Operation and Control*" Wiley India, 2nd edition

E-resources and other digital material

[1] http://kluweronline.com/

[2] https://nptel.ac.in/courses/108104013/

[3] https://nptel.ac.in/courses/108107114/

20EE7402A-OPTIMIZATION TECHNIQUES

Course Category:	**Program Elective-3**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Formulate** and **Solve** linear programming problems.
CO2	**Solve** non-linear programming problems, assignment and transportation problems.
CO3	**Apply** search methods to solve optimization problems.
CO4	**Understand** the basics of non-traditional optimization techniques and solve LPP using dynamic programming.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**											**1**	
CO2	**3**	**2**										**2**	**1**	
CO3	**3**	**2**											**1**	
CO4	**1**				**3**							**3**	**1**	

Course Content

UNIT-I **[Text Book-1]**

Linear Programming (LP): Introduction and formulation of models, standard and canonical forms of Linear Programming Problem(LPP), assumptions in LPP, simplex method, simplex method using artificial variables, degeneracy in simplex method, duality, dual simplex method and sensitivity analysis-change in coefficients of objective function.

UNIT-II **[Text Book-1]**

Assignment Problem: Hungarian method.

Transportation Problem: Vogel's approximation method, modified distribution method.

Non-linear Programming: Unconstrained problems of maxima and minima and constrained problems of maxima and minima, Lagrangian method and Kuhn Tucker conditions.

UNIT-III **[Text Book-2]**

Search Methods: Single Variable Search Methods-Exhaustive search, interval halving method and Fibonacci search, Multi Variable Search Methods-Univariate search method,

steepest descent method and conjugate gradient (Fletcher-Reeves) method.

UNIT-IV **[Text Book-1&3]**

Dynamic Programming: Solution of linear programming problem using dynamic programming, simple problems.

Heuristic Optimization Techniques: Fundamentals of evolutionary algorithms, trajectory based methods-genetic algorithm and swarm intelligence based algorithms-particle swarm optimization, advantages and disadvantages of non-traditional optimization techniques. Application of heuristic optimization methods to Electrical Engineering problems.

Text Books:

[1] S.D.Sharma, "*Operations Research*", Kedar Nath Ram Nathand Co, Latest edition.
[2] S.S.Rao, "*Engineering Optimization: Theory and Practice*", New Age International, Latest edition.
[3] K.Deb, "*Optimization for Engineering Design: Algorithms and Examples*", Prentice Hall of India Learning Pvt. Ltd., 2nd edition. 2012.

Reference Books:

[1] K.V.Mittal, C. Mohan, "*Optimization Methods in Operations Research and Systems Analysis*", New Age International, Latest edition
[2] H.A.Taha, "*Operations Research: An introduction*", Prentice Hall of India Learning Pvt. Ltd., Latest edition.
[3] D.P.Kothari, J.S.Dhillon, "*Power System Optimization*", Prentice Hall of India Learning Pvt. Ltd., 2nd edition, 2011.

E-resources and other digital material

https://www.nptel.ac.in/content/syllabus_pdf/112106064.pdf

20EE7402B-INTRODUCTION TO SMART GRID TECHNOLOGIES

Course Category:	**Program Elective-3**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the basics of smart grid architecture and its components.
CO2	**Understand** the information and communications technology for the smart grid
CO3	**Acquire** knowledge about sensing and measurement technologies and related measuring unit in smart grid.
CO4	**Know** the concept of smart metering and demand-side integration.

Contribution of Course Outcomes towards achievement of Program Outcomes(L - Low, M - Medium, H - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**							**1**	**2**		**3**			
CO2									**3**					**2**
CO3	**2**			**3**	**2**						**2**			**2**
CO4							**3**	**3**	**3**					**2**

Course Content

UNIT-I **[Text Book-1]**

Smart Grid Architectural Designs : Introduction, comparison of power grid with smart grid, power system enhancement, communication and standards, general view of the smart grid market drivers, stakeholder roles and function, measures, representative architecture, functions of smart grid components**.**

UNIT-II **[Text Book-2]**

Information and Communications Technology for the Smart Grid Data Communication: Introduction dedicated and shared communication channels, switching techniques, communication channels, layered architecture and protocols**.**

Communication Technologies for the Smart Grid: Introduction communication technologies-IEEE 802 series, mobile communications, multi-protocol label switching, power line communication, standards for information exchange, standards for smart metering Modbus, DNP3, IEC 61850.

Information Security for The Smart Grid: Encryption and decryption, authentication,

digital signatures, cyber security standards.

UNIT-III **[Text Book-1]**

Sensing and Measurement: Monitoring, PMU, smart meters, and measurements technologies-Wide Area Monitoring Systems (WAMS), Phasor Measurement Units (PMU), smart meters, smart appliances, advanced metering infrastructure, GPS and mapping tools, Multi Agent Systems (MAS) Technology.

UNIT-IV **[Text Book-2]**

Smart Metering and Demand-Side Integration: Introduction, smart metering-evolution of electricity metering, key components of smart metering, smart meters- an overview of the hardware used, communications infrastructure and protocols for smart metering, demand-side integration.

Text Books:

[1] J.Ekanayake, K.Liyanage, Wu.Jianzhong, A.Yokoyama, N.Jenkins, "*Smart Grid: Technology and Applications*" Wiley, 2012.

[2] J.Momoh, "*Smart Grid: Fundamentals of Design and analysis"*Wiley, IEEE Press, 2012.

Reference Book:

[1] Cl.W.Gellings, "*The Smart Grid, Enabling Energy Efficiency and Demand Side Response*" CRC Press, 2009.

E-resources and other digital material

[1] https://swayam.gov.in/nd1_noc19_ee64/preview

[2] https://nptel.ac.in/courses/108107113

20EE7402C-INDUSTRIAL DRIVES

Course Category:	Program Elective-3	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:		Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Acquire** basic concepts of electric drives.
CO2	**Apply** speed control methods of converter fed DC and Chopper fed DC drives.
CO3	**Apply** various speed control methods of induction motor drives, slip power recovery scheme.
CO4	**Analyze** various speed control methods of synchronous motor drive.

Contribution of Course Outcomes towards achievement of Program Outcomes (L - Low, M - Medium, H - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**1**											**2**	**1**
CO2	**3**	**2**	**2**	**3**		**1**							**2**	**3**
CO3	**3**	**2**	**2**	**3**		**1**							**2**	**3**
CO4		**2**	**2**	**3**		**1**							**2**	**3**

Course Content

UNIT-I **[Text Book-1]**

Introduction To Electric Drives: Advantages of electric drives, parts of electrical drives, choice of electric drives and selection of drives for various applications, fundamental torque equation, nature and classification of load torques, components of load torque, multi-quadrant operation, basic principles of closed-loop control.

UNIT-II **[Text Book-1]**

DC Motor Drives: Methods of speed control, speed control using single-phase and three-phase fully controlled and half controlled rectifiers in continuous and discontinuous mode of operation, speed control of DC motor drives using chopper control in continuous and discontinuous mode of operation.

UNIT-III **[Text Book-1]**

Induction Motor Drives: Methods of speed control, speed control of squirrel cage induction motor with v/f control, slip power recovery scheme, static Scherbius and

Krammer methods, variable frequency and variable voltage control using two-level voltage source inverter, AC and DC dynamic braking methods.

UNIT-IV **[Text Book-1]**

Synchronous Motor Drives: Speed control methods of synchronous motor drive.

Special Machines: Speed control of SRM, PMSM and BLDC motor, field weakening techniques.

Text Book:

[1] G.K.Dubey, "*Fundamentals of Electric Drives*", Narosa Publishers, 2nd edition, 2007.

Reference Books:

[1] V.Subramanyam, "*Electric Drives Concepts and Applications*", Tata McGraw HillPrivate.Ltd, 2nd edition, 2011.

[2] C.L.Wadhwa, "*Electrical Power Systems*", New Age international (P) Ltd, 2012.

[3] S.B.Dewan, G.R.Slemom, A.Straughen, "*Power semiconductor drives*", John Wiley and Sons, Latest edition

E-resources and other digital material

https://nptel.ac.in/courses/108108077

20EE7402C-ADVANCED POWER ELECTRONICS

Course Category:	Program Elective-3	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practice:	3-0-0
Prerequisites:	Power Electronics (20EE5302)	Continuous Evaluation: Semester End Evaluation: Total Marks:	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Analyze** the operation of non-isolated and isolated converters
CO2	**Elucidate** the operation of resonant converters
CO3	**Analyze** power quality problems and suggest solutions
CO4	**Design** of passive components used in power converters

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**				**3**	**3**							**3**
CO2	**3**	**3**	**3**				**3**							**3**
CO3	**3**	**3**				**3**	**3**							**3**
CO4			**3**			**3**			**3**					**3**

Course Content

UNIT-I **[Text Book-1]**

DC-DC Converters: Non-isolated DC-DC Converters-buck, boost, buck-boost, CUK converters under continuous and discontinuous conduction operation of Isolated DC-DC Converters-forward, fly-back, push-pull, half-bridge, and full-bridge converters, relationship between input and output voltages, expression for filter inductor and capacitors.

UNIT-II **[Text Book-1]**

Resonant Converters: Introduction, basic resonant circuit concepts, classification-Load resonant converters, resonant switch converters, zero voltage switching, clamped voltage converters, resonant DC link inverters, high frequency link integral half cycle converters, phase modulated resonant converters.

UNIT-III **[Text Book-1]**

Inverters: PWM techniques-single, multiple and sinusoidal PWM techniques, selective harmonic elimination, space vector modulation, multi-level inverters-diode-clamped, cascaded, and flying capacitor types, introduction to current source inverter.

UNIT-IV **[Text Book-1]**

Design of Power Converters Components: Design of magnetic components, design of transformer, design of inductor and current transformer, selection of filter capacitors, selection of ratings for devices, filter design, thermal design.

Text Book:

[1] E.W.Robert, M.Dragan,"*Fundamentals of Power Electronics*", Springer, 1997.

Reference Books:

[1] L.Umanand, *"Power Electronics: Essentials and Applications"*, chapter 1 to 7, John Wiley, India, 2009.

[2] N.Mohan, T.M.Undeland, WP.Robbins, "*Power Electronics: Converters and Applications*", John Wiley and Sons, 3rd edition, 2009.

[3] M.H.Rashid, "*Power Electronics-circuits, Devices and Applications*", Prentice Hall of India, 3rd edition, 2005.

E-resources and other digital material

https://nptel.ac.in/courses/108107128/

https://nptel.ac.in/courses/108108036/

Course material on Switched Mode Power Converters, SMPC_V Ramanarayanan.pdf

20EE4703A-VLSI DESIGN

Course Category:	**Program Elective-4**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Electronic Devices(20EE3302) Digital Electronics(20EE3305)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** VLSI fabrication processes for MOS, BICMOS technologies**.**
CO2	**Analyze** and **Design** NMOS, CMOS logic circuits using stick diagram and layout.
CO3	**Identify** the physical circuit parameters and analyze the effects of parasitic on overall performance of the circuits.
CO4	**Access** the effect of scaling on various device parameters**.**

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**1**													**2**
CO2			**2**	**2**										**2**
CO3				**2**										**2**
CO4				**2**										**2**

Course Content

UNIT-I **[Text Book-1]**

Introduction to MOS technology: The integrated circuit era, MOS VLSI technology, Basic MOS transistors, Enhancement mode transistor action, Depletion mode transistor action, NMOS fabrication, CMOS fabrication, BICMOS technology.

Basic Electrical Properties of MOS: Drain-to-Source current Ids Versus Voltage Vds relationships, Aspects of MOS transistor threshold Voltage V_T, MOS transistor conductance g_m and output conductance g_{ds}, MOS transistor figure of merit.

UNIT-II **[Text Book-1]**

MOS Circuits: Pass Transistor, NMOS inverter, pull-up to pull-down ratio for and NMOS inverter driven by one or more pass transistors, alternative forms of pull-up, CMOS inverter, Latch-up in CMOS circuits.

MOS Circuit Design Processes: MOS layers, stick diagrams, design rules and layout

UNIT- III **[Text Book-1]**

Basic Circuit Concepts: Sheet resistance Rs, Standard unit of capacitance, the delay unit, inverter delays, driving large capacitance loads, propagation delays, wiring capacitances, choice of layers.

UNIT-IV **[Text Book-1]**

Scaling of MOS Circuits: Scaling models and scaling factors, scaling factors for device parameters.

Subsystem Design and Layout: Architectural issues, switch logic, gate logic, examples of structured design (Combinational logic).

Text Book:

[1] D.A.Pucknell and K.Eshranghian, "*Basic VLSI Design*",Prentice Hall of India, 3rd edition,2005.

Reference Books:

[1] Wayne Wolf, "*VLSI Design: System-on-Chip Design*", 3rd edition, 2004.
[2] N.H.E.Weste and K.Eshranghian, "*Principles of CMOS VLSI Design-A system perspective*", Pearson Education, 2nd edition, 2002.

E-resources and other digital material

[1] https://cc.ee.ntu.edu.tw/~ywchang/courses/Vlsi2k/vlsi2k.html.
[2] https://faculty.kfupm.edu.sa/COE/elrabaa/coe360.html

20EE7403B-EMBEDDED SYSTEMS

Course Category:	**Program Elective-4**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Electronic Devices (20EE3302)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Illustrate** real time programming concepts.
CO2	**Apply** RTOS functions to **implement** embedded applications
CO3	**Understand** fundamentals of design consideration for embedded **applications**
CO4	**Understand** the case studies and apply independent skills according to the applications

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**													**2**
CO2				**2**										**2**
CO3				**2**										**2**
CO4	**3**													**2**

Course Content

UNIT-I **[Text Book-1]**

Introduction to Embedded Systems: Embedded systems, processor embedded into a system, embedded hardware units and devices, embedded software in a system, design process in embedded system, design process and design examples, classification of embedded systems, skill required for an embedded system designer.

UNIT-II **[Text Book-1]**

Devices and Communication Buses for Devices Network: I/O types and examples-serial communication devices, parallel device ports, sophisticated interfacing features in device ports, Timer and counting devices, watchdog timer, real time clock, networked embedded systems, serial communication protocol, parallel bus device protocols, internet enabled systems- network protocols.

UNIT-III **[Text Book-1]**

Programming Concepts and Embedded Programming in C, C++: Software programming in assembly language (ALP) vs. high level language, C Program elements, header and source files and preprocessor directives, Macros and functions, data types data structures, modifiers, statements, loops and pointers, embedded programming in C++.

UNIT-IV **[Text Book-1]**

Real Operating Time Systems: Multiple process in an application, multiple threads in an application, task states, task and data, concept of semaphores, shared data, inter process communication, signal function, semaphore function, mutex lock and spin lock-message queue functions, mail boxes-pipes-sockets.

Operating System Services, process management, timer function, memory management, device, file and subsystem, management Organization, interrupt routines handling in RTOS, RTOS task scheduling models, OS security issues.

Text Book:

[1] Rajkamal, "*Embedded Systems Architecture, Programming and Design*", Tata Mc. Graw Hill, 1st edition,Oct 2003.

Reference Books:

[1] S. Heath, "*Embedded Systems Design"*, 2nd edition, 2003.
[2] D.E.Simon, "*An Embedded Software Primer"*, Pearson Education Asia, 1st Indian Reprint 2000.
[3] W.Wolf, "*Computers as Components- Principles of Embedded Computing System Design"* Harcourt India, Morgan Kaufman Publishers, 1st Indian Reprint 2001.
[4] F.Vahid and T.Givargis, "*Embedded Systems Design - A unified Hardware /Software Introduction",* John Wiley, 2002.

E-resources and other digital material

[1] https://www.freertos.org/about-RTOS.html
[2] https://www.highintegritysystems.com/rtos/what-is-an-rtos
[3] http://dev.ti.com/tirex/content/simplelink_academy/rtos_concepts/rtos_concepts.html

20EE7403C- DIGITAL DESIGN WITH FPGA

Course Category:	**Program Elective-4**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the basics of programmable logic devices
CO2	**Understand** FPGA, Xilinx & ALTERA FPGAs architectures**.**
CO3	**Understand** the various abstraction levels in Verilog HDL and thus model tasks & functions at behavioral level.
CO4	**Design** the complex combinational and sequential logic circuits using various constructs in Verilog.

Contribution of Course Outcomes towards achievement of Program Outcomes(L - Low, M - Medium, H - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**							**1**	**2**		**3**			
CO2									**3**					**2**
CO3	**2**			**3**	**2**						**2**			**2**
CO4							**3**	**3**	**3**					**2**

Course Content

UNIT-I **[Text Book-1]**

Introduction to PLD: Programmable logic versus discrete logic, programmable logic versus Processors, types of programmable logic devices-PLA, PAL, CPLD - FPGA architecture - programming technologies-chip i/o- programmable logic blocks- fabric and architecture of FPGA.

UNIT-II **[Text Book-1]**

Xilinx and ALTERA FPGAs: Xilinx Virtex 5.0 architecture - Xilinx Virtex VI architecture – ALTERA cyclone II architecture - ALTERA stratix IV architecture.

UNIT-III **[Text Book-2]**

Verilog HDL – Data Flow & Structural Modeling: Lexical conventions - ports and modules – operators - gate level modeling - data flow modeling - system tasks & compiler directives - test bench.

Verilog HDL – Behavioral Modeling: Behavioral level modeling- procedural assignment statements- blocking and non-blocking assignments -tasks & functions - useful modeling techniques

UNIT-IV **[Text Book-1]**

Verilog Modeling of Combinational Circuits: Behavioral, data flow and structural realization of adders and multipliers.

Verilog Modeling of Sequential Circuits: synchronous and asynchronous FIFO – single port and dual port ROM and RAM - FSM verilog modeling of sequence detector - serial adder - vending machine**.**

Text Books:

[1] Ming-Bo Lin, "*Digital Systems Design and Practice: Using Verilog HDL and FPGAs"*, Create Space Independent Publishing Platform, 2nd edition, 2015.

[2] Michael D Ciletti, "*Advanced Digital Design with the Verilog HDL"*, Prentice Hall, 2nd edition , 2011.

Reference Book:

[1] Wayne Wolf, "*FPGA Based System Design*", Prentices Hall Modern Semiconductor Design Series, 2011.

[2] Charles H Roth Jr, Lizy Kurian John and Byeong Kil Lee "*Digital Systems Design using Verilog"*, Cengage Learning, 1st edition, 2016

E-resources and other digital material

[1] https://onlinecourses.nptel.ac.in/noc21_ee97

20EE7453D-DIGITAL CONTROLLERS LAB

Course Category:	**Program Elective-4**	**Credits:**	3
Course Type:	Practice	**Lecture-Tutorial-Practice:**	1-0-4
Prerequisites:	Microcontrollers (20EE5301)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Understand** the basics of assembly language programs for the digital signal processors
CO2	**Understand** different data transfer techniques in the digital signal processors
CO3	**Configure** and use Digital Input / Output lines and ADCs
CO4	**Configure** and use Event Managers for PWM generation

Contribution of Course Outcomes towards achievement of Program Outcomes(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		**3**		**3**	**3**									**2**
CO2		**3**		**3**	**3**									**2**
CO3		**3**		**3**	**3**						**3**			**2**
CO4		**3**		**3**	**3**						**3**			**2**

Course Content

LIST OF EXPERIMENTS

UNIT-I

Basic Programming

1. Program to perform the basic arthematic operations.
2. Program to perform maximum and minimum of numbers.
3. Program to find out square root of a number.
4. Program to generate trianguar, ramp up and ramp down waveforms.

UNIT-II

Data Transfer Techniques in Digital Signal Processors

5. Program to perform direct data transfer.
6. Program to perform indirect data transfer.
7. Program to transfer data from lower memory address to upper memory address.
8. Program to transfer data from upper memory address to lower memory address.

UNIT-III

Digital Input/Output Lines and ADCs

9. Program to display up counter on a LED board using the general purpose input and output pins.
10. Program to display down counter on a LED board using the general purpose input and output pins.
11. Program to display fibonacii series on a LED board using the general purpose input and output pins.
12. Program to interface the onboard analog to digital converter.

UNIT-IV

PWM Generation for Event Managers

13. Program to generate the pulses for a H-bridge inverter.
14. Program to generate the pulses for athree-phase inverter.
15. Program to generate the pulses for athree-phase inverter with dead band.
16. Program to generate the pulses for the DC DC converter.

Note: The above Programs can be executed in either 'C' or in Assembly language.

Text Books:

[1] H.A.Tolyat, "*DSP based Electromechanical Motion Control*"-CRC press, 2004.

[2] Application Notes from the website of Texas Instruments.

E-resources and other digital material

http://www.ti.com/lit/ds/symlink/tms320f28335.pdf

20EE7404A-ELECTRICAL DISTRIBUTION SYSTEMS

Course Category:	**Program Elective-5**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Power Generation and Transmission (20EE5303)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Summarize** distribution system planning and automation
CO2	**Describe** design considerations of sub-transmission lines and distribution substations.
CO3	**Describe** design consideration of primary and secondary systems.
CO4	**Analyze** the voltage drop & power loss calculations and effect ofcapacitors in distribution systems.

Contribution of Course Outcomes towards achievement of Program Outcomes(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**3**					**2**						**3**	
CO2	**3**	**2**	**2**	**3**			**1**						**2**	
CO3	**2**	**2**	**2**	**3**			**1**						**2**	
CO4	**3**	**2**	**2**	**3**			**2**						**3**	

Course Content

UNIT-I **[Text Book-1]**

Distribution Systems Planning and Automation: Introduction, distribution system planning, factors affecting system planning, substation site selection, present distribution planning techniques, distribution system planning in the future, central role of the computer in distribution planning, distribution system automation and control functions.

Load Characteristics: Basic definitions, relationship between load and loss factor, load management.

UNIT-II **[Text Book-1]**

Design of Sub-Transmission Lines and Distribution Substations: Introduction, sub-transmission systems, distribution substation, substation bus schemes, description and comparison of switching schemes, substation location, rating of a distribution substation, substation service area with n primary feeders, comparison of four and six feeder patterns.

UNIT-III **[Text Book-1]**

Design Consideration of Primary Systems: Introduction, types of feeders-radial type, loop

type primary feeders, primary network, primary feeder voltage levels, primary feeder loading, and radial feeders with uniformly distributed load and non-uniformly distributed loads.

Design Consideration of Secondary Systems: Introduction, secondary voltage levels, secondary banking, secondary networks-grid network, spot network, secondary mains, distribution system protection-basic definitions, over current protection devices-fuses, automatic circuit re-closers, automatic line sectionalizers, automatic circuit breakers, objectives of distribution system protection, coordination of protective devices-fuse to fuse co-ordination, re-closer to fuse coordination, fuse to circuit breaker co-ordination, re-closer to circuit breaker co-ordination.

UNIT-IV **[Text Book-1]**

Voltage Drop and Power Loss Calculations: Voltage drop and loss calculation in three phase balanced primary lines, method to analyze distribution costs.

Capacitors in Distribution Systems: Application of capacitors in distribution systems, effect of series and shunt capacitors, power factor correction-concept of leading and lagging power factors, economic power factor, economic justification for capacitors, procedure to determine the best capacitor location, distribution system voltage regulation, quality of service, voltage control and line drop compensation.

Text Book:

[1] T.Gonen, "*Electric Power Distribution system Engineering*" CRC press, Latest edition.

Reference Books:

[1] Jr.A.S.Pabla, "*Electric Power Distribution*", Tata McGraw Hill Ltd, Latest edition.
[2] V Kamaraju "*Power Distribution Systems*" Tata McGraw Hill Publishing Company, 2nd edition, 2010.
[3] Dale R.Patrick, Stephen W.Fardo, "*Electrical Distribution Systems*" CRC Press, Special Indian,2ndedition.
[4] T.A. Short, "*Electric Power Distribution*" Hand Book, CRC Press

E-resources and other digital material

[1] https://nptel.ac.in/courses/108/107/108107112/
[2] https://nptel.ac.in/courses/108/108/108108099/
[3] https://nptel.ac.in/courses/108/106/108106025/

20EE7404B- HIGH VOLTAGE ENGINEERING

Course Category:	**Program Elective-5**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-2
Prerequisites:		**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Elucidate** the concepts used for the generation of high voltages, impulse voltages & currents and **design the** corresponding circuits.
CO2	**Elucidate** the concepts used for the measurement of high voltages and current and **design** the corresponding circuits
CO3	**Distinguish** high voltage testing techniques of power apparatus.
CO4	**Understand** the breakdown phenomenon in various types of insulating materials.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			3							2	
CO2	2	2	2			3							2	
CO3	1	2	2			3							2	
CO4	3	2	2			3							2	

Course Content:

UNIT-I **[Text Book-1&2]**

Generation of High DC and AC Voltages: Principle of voltage doublers circuit, Cockcroft-Walton cascade arrangement, and its mathematical analysis; cascade connection of transformers, resonant transformers and Tesla coil.

Generation of Impulse Voltages and currents:

Standard specifications, standard wave shapes for testing, properties of double exponential wave shapes, approximate estimate of wave shape control resistors, multistage impulse generator and energy of impulse current generator.

Experiments in laboratory : Design of Voltage Doubler Matlab Simulink model, cascaded transformer Matlab Simulink model, Small Voltage Multiplier circuit design in lab.

UNIT-II **[Text Book-1&2]**

Measurement of High Voltages and Currents: DC, AC and impulse voltages and currents, CRO/DSO electrostatic and peak voltmeters, sphere gaps, factors affecting measurements, potential dividers, series impedance ammeters, Rogowski coils.

Experiments in laboratory: Impulse voltage Generation and measuring in Digital Storage Oscilloscope, Analysis the Wave Impulse voltage in DSO.Measurement of dielectric strength of air using different electrodes.

UNIT-III **[Text Book-1]**

High Voltage Testing Techniques: Testing of insulators, bushings, isolators and circuit breakers, cables, transformers and surge arresters.

Experiments in laboratory: High Voltage Testing of insulators and cables, measurement of leakage current in lighting arrester, Impulse voltage testing of insulators and cables.

UNIT-IV **[Text Book-1&2]**

Breakdown of Insulators-Solid, Liquid and Gas Dielectrics: Gases as insulating media, Townsend's current growth equation, current growth in the presence of secondary processes, streamer theory, Paschen's law, Pure liquids and commercial liquids, conduction and breakdown in pure liquids, intrinsic breakdown, breakdown of solid dielectrics in practice.

Experiments in laboratory: Dielectric strength of vacuum with different electrodes and different gaps, Dielectric strength of air at different air pressure with different electrodes and gaps, Measurement of dielectric strength of transformer oil with different electrodes and gaps, Study of dielectric strength of solid insulating materials.

Text Books:

[1] M.S.Naidu and V.Kamraju, "*High Voltage Engineering*", Tata Mc. Graw Hill Pvt. Ltd, 5th edition, 2012.

[2] C.L. Wadhwa, "*High Voltage Engineering*", New Age International publications, Latest edition.

Reference books:

[1] E.Kuffel, W.S.Zaengl and J.Kuffel, "*High Voltage Engineering Fundamentals*", Elsevier Publication, 2nd edition, 2005.

[2] M.S.Naidu, "*Gas Insulated Substations*", I.K International Publishing House Pvt. Ltd. 2008

E-resources and other digital material

http://nptel.ac.in/courses/108104048/ui/TOC.htm

20EE7404C-POWER QUALITY

Course Category:	**Program Elective-5**	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Power Generation and Transmission (20EE5301) Power System Protection (20EE6302)	**Continuous Evaluation:** **Semester End Evaluation:** **Total Marks:**	30M 70M 100M

Course outcomes

	Upon successful completion of the course, the student will be able to:
CO1	**Understand** and **assess** the severity of different power quality problems.
CO2	**Analyze** voltage sag problems and suggest preventive techniques.
CO3	**Understand** the fundamentals of harmonics and mitigation techniques.
CO4	**Assess** the effect of DG in power quality problems and know power quality monitoring.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**3**											**2**	
CO2	**2**	**2**	**3**	**2**			**1**						**2**	
CO3	**3**	**3**	**3**	**2**			**1**						**3**	
CO4	**2**	**2**	**3**				**2**						**3**	

Course Content

UNIT-I **[Text Book-1]**

Overview: Power quality definition, the power quality evaluation procedure, general classes of power quality problems- transients, short duration and long duration voltage variations, voltage imbalance, waveform distortion, voltage fluctuations, power frequency variation, Power acceptability curves-CBEMA and ITI Curves.

UNIT-II **[Text Book-1]**

Voltage Sags and Interruptions: Sources of sags and interruptions, estimating voltage sag performance-area of vulnerability, equipment sensitivity to voltage sags, transmission system and utility distribution system, sag, performance evaluation, fundamental principles of protection, solutions at the end user level, ferro resonant transformers, magnetic synthesizers, standby UPS, hybrid UPS and superconducting magnetic energy storage (SMES) devices.

UNIT-III **[Text Book-1& 2]**

Fundamentals of Harmonics: Harmonic distortion, voltage versus current distortion, harmonics versus transients, power system quantities under non-sinusoidal conditions, harmonic indexes, harmonic sources from commercial loads, harmonic sources from industrial loads, effects of harmonic distortion-impact on capacitors, transformers, motors and telecommunications, inter harmonics, harmonic current mitigation

UNIT-IV **[Text Book-1]**

Distributed Generation and Power Quality: Resurgence of DG, DG technologies, interface to the utility system, power quality issues.

Power Quality Monitoring: Monitoring consideration, power quality measuring instruments-wiring and grounding testers, power analyzer, oscilloscopes, disturbance analyzers.

Text Book:

[1] R.C.Dugan, MF.Mc.Granaghan, S.Santoso and HW. Beaty, "*Electrical Power Systems Quality*", McGraw Hill, Latest edition.

[2] Sankaran. C, "Power Quality", CRC Press, 2017.

Reference Books:

[1] J.Arrillaga, N.R. Watson, "*Power System Harmonics*", John Wiley and Sons.

[2] A.Baggini, "*Handbook of Power Quality*",John Wiley and Sons.

[3] M.H.J.Bollen, "*Understanding Power Quality Problems- Voltage sag and Interruptions*", IEEE Press.

[4] S.Chattopadhyay, M.Mitra, and S.Sengupta, "*Electric Power Quality*", Springer.

E-resources and other digital material

https://nptel.ac.in/courses/108/106/108106025/

20EE7454D-PLC & SCADA LAB

Course category:	**Program Elective-5**	**Credits:**	3
Course type:	Practice	**Lecture-Tutorial-Practice:**	1-0-4
Prerequisites:	Programmable logic controller(20EE6404B)	**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

Course outcomes	
	Upon successful completion of the course, the student will be able to:
CO1	**Design** and conduct experiment.
CO2	**Analyze** and present experiment results.
CO3	**Exhibit** Professional behaviour.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 - Low, 2 - Medium, 3 - High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**		**3**	**1**	**1**						**3**		**2**	**3**
CO2			**3**							**3**	**3**		**2**	
CO3			**3**							**3**				

Course Content

PART-A: Concepts of PLC & SCADA

1. Implementation of selection criteria and bit logic operations in PLC.
2. Industrial applications of TIMERS in PLC.
3. Industrial applications of counters in PLC.
4. Applications of "Move" operation and analog value processing.
5. Implementation of RT and RC packages, tags and configuration of PLC to SCADA communication.
6. SCADA screen designing with movements, animations and symbols etc.
7. User administration and recipes in SCADA.
8. Implementation of reports and trends in SCADA.

PART-B: Case Studies

1. Home automation using PLC and SCADA.
2. Implementation of elevator control system using PLC and SCADA.
3. Nuclear power plant Modeling using PLC and SCADA.
4. Thermal power plant modeling using PLC and SCADA.
5. Beverage preparation and bottle filling using PLC and SCADA.
6. Product sorting and machine bypassing using PLC and SCADA.
7. Implementation of batch processing using PLC and SCADA.
8. Multi level car parking design using PLC and SCADA

Note: Part A is mandatory and any **Four** experiments from **Part B** are to be completed

24EE7205-Course Title: MOOCS*

Course category:	**Open Elective-3**	**Credits:**	3
Course type:	Self-Learning course*	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

MOOCS*: The NPTEL Course will be declared at beginning of the semester

24EE7206-Course Title: MOOCS*

Course category:	**Open Elective-4**	**Credits:**	3
Course type:	Self-Learning course*	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30M
		Semester End Evaluation:	70M
		Total Marks:	100M

MOOCS*: The NPTEL Course will be declared at beginning of the semester

SEMESTER VIII CONTACT HOURS: 24

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	20EE8551	Internship/Project**	Major Project & Internship (6 Months)	0	0	24	12
			Total	0	0	24	12

** The student should undergo internship and simultaneously he/she should work on a project with well-defined objectives. At the end of the semester the student should submit an internship completion certificate and a project report.