BMS COLLEGE OF ENGINEERING, BENGALURU-19
(Autonomous Institute, Affiliated to VTU)

BACHELOR OF ENGINEERING

DEPARTMENT
OF
INFORMATION SCIENCE AND ENGINEERING

SCHEME & SYLLABUS
III - VI SEMESTERS
(Academic Year: 2020-21)

INSTITUTE VISION

Promoting Prosperity of mankind by augmenting Human Resource Capital through Quality Technical Education & Training.

INSTITUTE MISSION

Accomplish Excellence in the field of Technical Education through Education, Research and Service needs of society.

DEPARTMENT VISION

Promote Quality Human Resource Capital by inculcating in every student the art of Creativity and Productivity in the field of Information Technology.

DEPARTMENT MISSION

Offer High Quality Graduate, Post Graduate Programme in Information Technology to prepare students for higher studies and professional career in industry.

Provide good Teaching and Research environment for Quality Education in the field of Information Technology.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Excel as IT Professional with Proficiency in designing solutions to Information Engineering problems.

PEO2: Pursue higher studies with the sound knowledge of basic concepts and skills in science and IT disciplines.

PEO3: Exhibit professionalism, team work and expose to current trends towards continuous learning.

PROGRAMME OUTCOMES (POs)

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 life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Apply and Analyze the concepts of Computer Networks to provide solution for evolving needs in Information Technology

PSO2: Demonstrate knowledge of Software Engineering and Data Science with competence in programming languages to solve real-world problems.

PSO3: Apply principles of information systems in the field of engineering for proficient solutions
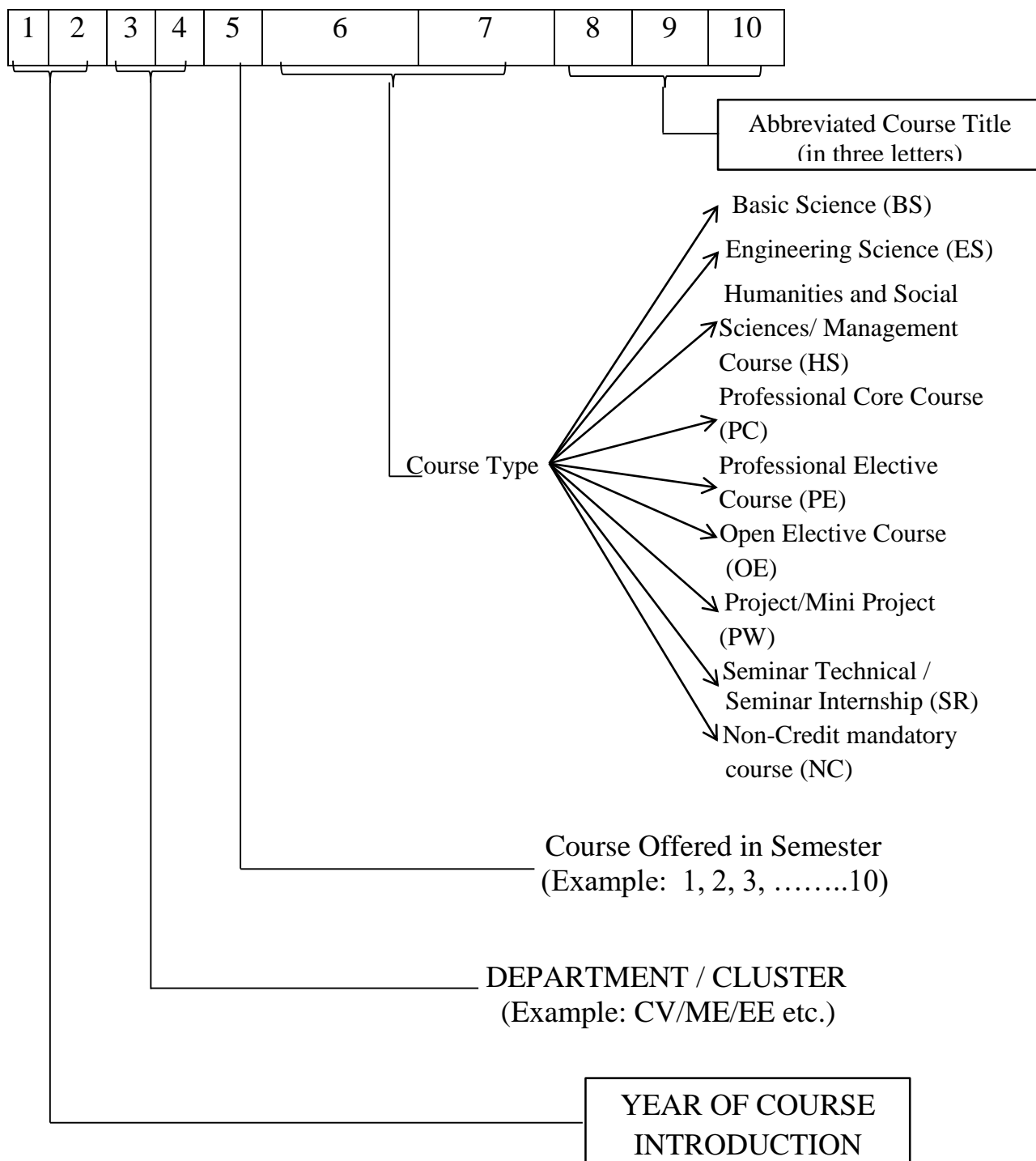
NOMENCLATURE FOR THE COURSE CODE

1	2	3	4	5	6	7	8	9	10

Abbreviated Course Title
(in three letters)

Course Type

- Basic Science (BS)
- Engineering Science (ES)
- Humanities and Social Sciences/ Management Course (HS)
- Professional Core Course (PC)
- Professional Elective Course (PE)
- Open Elective Course (OE)
- Project/Mini Project (PW)
- Seminar Technical / Seminar Internship (SR)
- Non-Credit mandatory course (NC)

Course Offered in Semester
(Example: 1, 2, 3, ……..10)

DEPARTMENT / CLUSTER
(Example: CV/ME/EE etc.)

YEAR OF COURSE INTRODUCTION

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Scheme of Instructions

Semester – III

(With effect from the Academic Year 2019-20)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
BS-5	19MA3BSSDM	Statistics & Discrete Mathematics	3	1	0	4	50	50	100
ES-7	19IS3ESOPS	Operating System	3	1	0	4	50	50	100
PC-1	19IS3PCDSC	Data Structures with C	3	0	1	4	50	50	100
PC-2	19IS3PCOOP	Object Oriented Programming using C++	3	0	1	4	50	50	100
PC-3	19IS3PCDLD	Digital Logic Design	2	1	0	3	50	50	100
PC-4	19IS3PCCOA	Computer Organization and Architecture	3	0	0	3	50	50	100
HS-1	19IC3HSEVS	Environmental Studies	2	0	0	2	50	50	100
PW-1	19IS3PWWAD	Web Application Development	0	0	2	2	50	50	100
NC-3	19IS3NCNPT	NPTEL	Non-credit mandatory Course						
		TOTAL	18	3	4	26	400	400	800

PW-1: Students should develop websites using modern web technologies. The course will be executed in two lab cycles and a project work. During Cycle 1, the students would be able to design responsive web portals using HTML, CSS and Bootstrap framework. In Cycle 2, both client and server side scripting will be used to build interactive websites using Session management and databases. In the Project work phase, student will design and develop complete end to end web portals based on requirements and design considerations.

NC-3: Student should register for any of the computer/IT related online NPTEL courses under the guidance of respective proctor and submit the performance certificate.

Note: HS: Humanities and Social Sciences/Management Course, BS: Basic Science Course, ES: Engineering Science Course, PC: Professional Core Course, PE: Professional Elective Course, OE: Open Elective Course; PW: Project/Mini Project Work, SR: Seminar Technical / Seminar Internship, NC: Non-credit mandatory course

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
Scheme of Instructions **Semester – IV** **(With effect from the Academic Year 2019-20)**									
BS-6	19MA4BSLIA	Linear Algebra	3	1	0	4	50	50	100
PC-5	19IS4PCDBM	Database Management System	3	0	1	4	50	50	100
PC-6	19IS4PCADA	Analysis and Design of Algorithms	3	0	1	4	50	50	100
PC-7	19IS4PCJAV	Java Programming	3	0	1	4	50	50	100
PC-8	19IS4PCTFC	Theoretical Foundations of Computations	3	1	0	4	50	50	100
HS-2	19IS4HSCPH	Constitution of India, Professional Ethics & Human Rights	1	0	0	1	50	50	100
SR-1	19IS4SRSMI	Seminar Based on Summer/Winter Internship	1	0	0	1	50	50	100
PW-2	19IS4PWUSP	UNIX System Programming	0	0	2	2	50	50	100
NC-4	19IS4NCPAE	Participation in any Activity/Event	Non-credit mandatory Course						
		TOTAL	18	2	5	24	400	400	800

SR-1: Technical Seminar is based on **i.** Summer/Winter Internship done during the vacation period or **ii.** Research paper on recent Technology.

PW-2: Student should explore UNIX commands, shell scripts and APIs related to files and process, emulate UNIX commands and develop applications related to UNIX operating system in a team of two members. The evaluation of project work will be based on the rubrics set.

NC-4: Student must participate in some activity or event [Cultural, Technical, Spiritual, Social or Sports] either in the college/department or outside the college and produce participation certificate for clearing this non-credit mandatory course.

Note: HS: Humanities and Social Sciences/Management Course, BS: Basic Science Course, ES: Engineering Science Course, PC: Professional Core Course, PE: Professional Elective Course, OE: Open Elective Course; PW: Project/Mini Project Work, SR: Seminar Technical / Seminar Internship, NC: Non-credit mandatory course

Scheme of Instructions

Semester – V

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
PC-9	20IS5PCMLG	**Machine Learning**	3	0	1	4	50	50	100
PC-10	20IS5PCCLC	**Cloud Computing**	2	0	1	3	50	50	100
PC-11	20IS5PCDCN	**Computer Networks - 1**	3	0	1	4	50	50	100
PC-12	20IS5PCSEO	**Software Engineering and Object Oriented Modeling Design**	3	1	0	4	50	50	100
HS-3	20IS5HSEMR	**Entrepreneurship, Management and IPR**	2	0	0	2	50	50	100
PW-3	20IS5PWMAD	**Mobile Application Development**	0	0	2	2	50	50	100
PE-1	20IS5PEIOT	**Internet of Things**	2	0	1	3	50	50	100
	20IS5PERPA	**Robotic Process Automation Design and Development**							
	20IS5PEDMG	**Data Mining**							
	20IS5PEAPP	**Advanced Python Programming**							
PE-2	20IS5PEADS	**Advanced Data Structures and Algorithms**	3	0	0	3	50	50	100
	20IS5PECDN	**Compiler Design**							
	20IS5PEAIS	**Artificial Intelligence**							
	20IS5PECGS	**Computer Graphics**							
NC-5	20IS5NCMOC	**MOOC**	**Non-credit mandatory Course**						
		TOTAL	18	1	6	25	400	400	800

PW-3: A team of students of different engineering streams must be formed and allowed to propose and implement a problem which lies in the multidisciplinary area and has a societal impact.

NC-5: Student should register for some online MOOC[NPTEL, COURSERA, SWAYAM, …] courses under the guidance of respective proctor and should submit the performance certificate

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Scheme of Instructions
Semester – VI
(With effect from the Academic Year 2020-21)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
PC-13	20IS6PCCNS	**Cryptography and Network Security**	3	0	0	3	50	50	100
PC-14	20IS6PCCON	**Computer Networks - 2**	3	0	1	4	50	50	100
PC-15	20IS6PCSTG	**Software Testing**	3	0	1	4	50	50	100
HS-4	20IS6HSPMF	**Software Project Management and Finance**	2	0	0	2	50	50	100
PE-3	20IS6PESAO	**Software Architecture and Design Patterns**	2	1	0	3	50	50	100
	20IS6PESNA	**Social Network Analysis**							
	20IS6PEBDA	**Big Data Analytics**							
	20IS6PEPRN	**Pattern Recognition**							
PE-4	20IS6PEMCT	**Mobile Computing and 5G Technologies**	2	0	1	3	50	50	100
	20IS6PENLP	**Natural Language Processing**							
	20IS6PEDLG	**Deep Learning**							
	20IS6PEDIP	**Digital Image Processing**							
OE1	20IS6OEDSA	**Data Structures and Algorithms**	3	0	0	3	50	50	100
	20IS6OERPA	**Robot Process Automation Design and Development**							
PW-4	20IS6PWMPR	**Multi-disciplinary Project**	0	0	2	2	50	50	100
SR-2	20IS6SRITR	**Seminar Based on Summer/Winter Internship**	1	0	0	1	50	50	100
NC-6	20IS6NCPAE	**Participation in any Activity/Event**	**Non-credit mandatory Course**						
		TOTAL	19	1	5	25	400	400	800

Open Elective-1: Students can select any one of the open electives offered under OE-1 by any Department of the institution. Student can opt the course under OE-1 if, **i.** The candidate has not studied the same course during the previous semesters of the programme. **ii.** The syllabus content of open elective is not similar to any of the professional core or professional elective courses of his/her programme. **iii.** A similar course, under any category is not prescribed in the higher semesters of his/her programme.

PW-4: A team of students of different engineering streams allowed to identify a problem and propose and implement a solution which lies in the multidisciplinary area and has a societal impact.

SR-2: Technical Seminar Based on **i.** Summer/Winter Internship work done during the vacation period of 4th and 5th Sem **ii.** Research paper of recent Technology trends.

NC-6: Student must participate in some activity or event [Cultural, Technical, Spiritual, Social or Sports] conducted by college/department clubs in the college or outside the college and produce participation certificate for clearing this non-credit mandatory course.

Scheme of Instructions
Semester – VII
(With effect from the Academic Year 2021-22)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
BS-7	20IS7BSBIO	**Biology for Engineers**	2	0	0	2	50	50	100
HS-5	20IS7HSCLF	**Cyber Law and Forensic**	3	0	0	3	50	50	100
PE-5	20IS7PEBEA	**Business Enterprise Architecture**	3	0	0	3	50	50	100
	20IS7PEDVP	**Devops**							
	20IS7PEDVR	**Data Visualization and Reporting**							
	20IS7PEVRR	**Virtual Reality**							
OE-2	20IS7OEJVP	**Java Programming**	3	0	0	3	50	50	100
	20IS7OEMLG	**Machine Learning**							
PW-5	20IS7PWCP1	**Capstone Project - 1**	0	0	3	3	50	50	100
SR-3	20IS7SRTLS	**Technical Seminar (Based on review of Research Publication/ Patent)**	1	0	0	1	50	50	100
PC16	20IS7PCIMC	**Industry Motivated Course**	1	0	0	1	50	50	100
PC17	20IS7PCIST	**Information Security**	3	0	0	3	50	50	100
NC-7	20IS7NCPDC	**Personality Development and Communication/Aptitude Skills**	**Non-credit mandatory Course**						
	TOTAL		16	0	3	19	400	400	800

Open Elective-2: Students can select any one of the open electives offered under OE-2 by any Department of the institution if, **i.** The candidate has not studied the same course during the previous semesters of his/her programme. **ii.** The syllabus content of open elective is not similar to any of the professional core or professional elective courses his/her programme. **iii.** A similar course, under any category is not prescribed in the higher semesters of the programme.

Capstone Project - I - Students must form a team of minimum two or maximum three members and enroll for Capstone Project-I. Each team must develop the Capstone Project proposal on a question or problem of their choice by carrying out a detailed literature Survey under the guidance of a faculty mentor, and secure approval of the proposal from a faculty mentor and the Capstone Project instructor.

Technical Seminar SR-3: Each student must make a presentation on the technical topic based on the Research publication or patent [IEEE, Springer, Elsevier or any standard journals] selected of their choice under the guidance of a faculty mentor.

NC-7: Student should participate in a Personality Development & Communication (PDC)/Aptitude Skills Programme conducted by any organization and submit the participation certificate of PDC/Aptitude for clearing this mandatory course.

Scheme of Instructions

Semester – VIII

(With effect from the Academic Year 2021-22)

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
HS-6	20IS8HSGCG	**Green Computing**	2	0	0	2	50	50	100
OE-3	20IS8OEBDA	**Big Data Analytics**	3	0	0	3	50	50	100
	20IS8OEWTS	**Web Technologies**							
PW-6	20IS8PWCP2	Capstone Project - 2	0	0	10	10	50	50	100
SR-4	20IS8SRITR	**Seminar Based on Summer/Winter Internship with a government organization or any other organization or a premier Institute or a Research Lab**	1	0	0	1	50	50	100
NC8	20IS8NCPCE	**Any Competitive Examination**	**Non-credit mandatory Course**						
		TOTAL	6	0	10	16	200	200	400

Open Elective-3: Students can select any one of the open electives offered under OE-3 by any Department of the institution. Student can opt the course under OE-1 if, **i.** The candidate has not studied the same course during the previous semesters of the programme. **ii.** The syllabus content of open elective is not similar to any of the professional core or professional elective courses. **iii.** A similar course, under any category is not prescribed in the higher semesters of the programme.

Capstone Project-2: The same Team of students[Capstone Project-1] should continue with the Implementation and demonstration of the Capstone Project-2 and produce a substantial paper that reflects a deep understanding of the topic

SR-5: Seminar 5 is based on **i.** Summer/Winter Internship done with any company or research lab for two months during the vacation period or during 8th Semester.

NC-8: Student must take up some competitive exams like GATE, TOEFL, GRE etc. and submit the passing certificate/ score card to clear this course

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	STATISTICS AND DISCRETE MATHEMATICS				
Course Code	19MA3BSSDM	Credits	4	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours		36	

UNIT – 1	11Hrs
GRAPH THEORY: Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonian graphs, sub-graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, minimal spanning tree: Kruskal's algorithm, Prim's algorithm, shortest path-Dijkstra's algorithm. **(8L+3T)**	
UNIT – 2	**9 Hrs**
COMBINATORICS: Principles of counting: The rules of sum and product, permutations. Combinations- Binomial and multinomial theorems. Catalan numbers, the principle of inclusion and exclusion. Derangements. **(7L+2T)**	
UNIT – 3	**8 Hrs**
PROBABILITY: Theoretical distributions: Poisson distribution, Exponential and Normal distributions. Joint probability distributions: Discrete random variable, Mathematical expectations, Covariance and Correlation. **(6L + 2T)**	
UNIT – 4	**11 Hrs**
STATISTICAL INFERENCE: Introduction, procedure for testing of hypothesis, level of significance[Large sample] Test of significance for single mean, difference between two means, single proportion, difference between two proportions. [Small sample] Test of significance for single mean, difference between two means, paired t-test, ratio of variances (F- distribution), Chi-Square distribution-goodness of fit. **(8L+3T)**	
UNIT – 5	**9 Hrs**
MARKOV CHAIN AND QUEUING THEORY: Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chains. Queuing Models: Concept of Queue, M/M/1 queuing system. **(7L+2T)**	

Text Books :

1. Discrete Mathematics, Seymour Lipchitz. M. Lipson, 2005, Tata McGraw Hill.
2. Graph Theory and Combinatorics, D. S. Chandrasekharaiah, 4th edition, 2011-12, Prism Engineering Education Series.
3. Higher Engineering Mathematics, B. V. Ramana, 2007, Tata McGraw Hill.

Reference Books :

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, 2002, McGraw Hill.

2. Discrete Mathematics, Kolman, Busby Ross, 5th edition, 2004, Prentice Hall.
3. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Eastern Economy Edition, PHI Learning Pvt., Ltd

e-Books :

1. http://jlmartin.faculty.ku.edu/~jlmartin/courses/math725-S16/
2. https://www.whitman.edu/mathematics/cgt_online/cgt.pdf

Online Courses and Video Lectures:
1. https://www.coursera.org/learn/probability-intro
2. https://nptel.ac.in/courses/111104026/ (Discrete Mathematics)
3. https://nptel.ac.in/courses/111106086/ (Combinatorics)
4. https://nptel.ac.in/courses/111102112/ (Statistical Inference)

COURSE OUTCOMES (COs)
At the end of the course, the student will be able to

CO1	Use graphs as representation tool in network analysis.
CO2	Demonstrate an understanding of the basic concepts of combinatorics.
CO3	Apply the concepts for probability, Statistics and Queuing theory.

Course Title	OPERATING SYSTEM				
Course Code	19IS3ESOPS	Credits	4	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36

UNIT – 1	7 Hrs

Introduction: Operating System structure, Operating System operations, Process management, Memory management, Storage management, Protection and security, Kernel data structures, computing environments.

Operating System structure: Operating System Services, User- Operating System interface, System Calls, Types of system calls, system programs, Operating System design and implementation.

UNIT – 2	7 Hrs

Processes: Process Concept, Process Scheduling, Interprocess communication.

Threads: Overview, Multithreading models, Threading issues.

Process Synchronization: The critical section problem, Peterson's solution, Mutex locks, Semaphores, Classical problems of synchronization.

UNIT – 3	8 Hrs

CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms.

Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock.

UNIT – 4	8 Hrs

Main Memory: Background, swapping, Contiguous memory allocation, Segmentation, Paging, Structure of page table.

Virtual Memory: Background, Demand paging, Copy on write, Page replacement algorithms, Allocation of frames, Thrashing.

UNIT – 5	6 Hrs

Disk performance optimization: Introduction, Why disk scheduling is necessary, Disk scheduling strategies, rotational optimization.

File and Database Systems: Free space management, File access control.

Case study: Linux systems – Design principles, kernel modules, File system.

Text Books :

1. Operating System Concepts, by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 9th Edition, Wiley India, 2012.
2. Operating systems, by H.M.Deitel, D.J.Deitel, D.R.Choffnes, 3rd edition, Pearson Education.

Reference Books :
1. Operating Systems, A Concept-Based Approach, by DM Dhamdhere, 3rd Edition, Tata Mcgraw-Hill, 2012.   2. Modern Operating Systems, by Andrew S. Tanenbaum and Herbert Bos, 4th Edition, Pearson, 2014.
e-Books :
1. http://iips.icci.edu.iq/images/exam/Abraham-Silberschatz-Operating-System-Concepts9th2012.12.pdf   2. http://materias.fi.uba.ar/7508/MOS4/Operating.Systems.4th.Edi.pdf
MOOCs
1. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/index.html   2. https://www.udacity.com/course/introduction-to-operating-systems--ud923

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the basic concepts of operating system structures, services and functionalities.
CO2	Apply various concepts to solve problems related to synchronization, deadlocks, memory management, CPU scheduling.
CO3	Compare different algorithms of CPU scheduling, Page replacement, storage management and disk scheduling.
CO4	Analyze appropriate algorithm for the given CPU processes, deadlock occurrences and memory management.
CO5	Demonstrate the algorithms used for CPU scheduling and disk scheduling using OS sim.

Course Title	DATA STRUCTURES WITH C				
Course Code	19IS3PCDSC	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36

UNIT – 1	8 Hrs
Introduction to Data Structures: Definition and its classification, Dynamic Memory allocation. **Linked Lists:** Definition, Basic Operations on Singly Linked List, Singly linked List with Header Nodes, Applications of Singly Linked Lists.	

UNIT – 2	7 Hrs
Linked List: Doubly Linked Lists, Circular Linked List – Implementation and Applications **Stacks:** Definition, Operations, Implementation using Arrays and Linked list, Applications of Stack – Infix to postfix conversion, Evaluation of postfix expression.	

UNIT – 3	6 Hrs
Recursion: Definition, Writing recursive programs, Efficiency of Recursion. **Queues:** Definition, Operations, Implementation using Arrays and Linked list, Types of queues – Circular queue, Deque and priority queue, Applications of queues.	

UNIT – 4	7 Hrs
Binary Trees: Binary Tree properties and representations, traversals and other operations. **Binary Search Trees:** Definition, Operations on BST, Threaded binary trees, Applications.	

UNIT – 5	8 Hrs
Balanced Trees: AVL Trees, Splay trees, Red- Black Trees – Definitions, Rotation and other basic operations.	

Text Books :

1. Data Structures using C and C++, Yedidyah, Augenstein, Tannenbaum, 2nd Edition, Pearson Education, 2007.

2. Data Structures using C, Reema Thareja, 2nd Edition, Oxford University Press, 2011

Reference Books :

1. Fundamentals of Data Structures in C, by Horowitz, Sahni, Anderson-Freed, 2nd Edition, Universities Press, 2007.

2. Data Structures A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan,,Cengage Learning, 2005.

e-Books :
1. https://tinyurl.com/y9kdozyq 2. https://tinyurl.com/z8wln87
MOOCs
1. https://www.edx.org/course/data-structures-an-active-learning-approach 2. https://www.coursera.org/specializations/data-structures-algorithms

COURSE OUTCOMES (COs)
At the end of the course, the student will be able to

CO1	Apply principles of Data Structures for solving problems.
CO2	Analyse and Develop operations on linear and non-linear data structures.
CO3	Design and formulate various methods of organizing data.
CO4	Conduct experiments to implement operations like searching, insertion, deletion, traversal mechanism on various data structures.
CO5	Demonstrate data structure coding skills on a competitive programming platform
CO6	Make effective presentations on the implementations of applications on data structures.

Course Title	OBJECT ORIENTED PROGRAMMING USING C++				
Course Code	19IS3PCOOP	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36

UNIT – 1	6 Hrs

Introduction: Overview to Object Oriented Programming, Benefits and applications of Object Oriented Programming.

Beginning with C++: Program structure, cin and cout objects, namespace, identifiers, variables, constants, operators, reference types, typecasting, control structures.

Objects and Classes: Basics of object and class in C++, Private and public members, Specifying a class, C++ program with a class, arrays within a class, memory allocation to objects, array of objects.

UNIT – 2	8 Hrs

Functions in C++: Functions, Inline function, function overloading, default arguments, friend functions, static data and function members, Objects as function arguments, returning objects, constant member functions and objects, this pointer.

Constructors and Destructors: Constructors and its types – Default constructors, Parameterized constructors, multiple constructors in a class, Constructors with default arguments, dynamic initialization of objects, Copy constructor, Dynamic constructors, Destructors.

UNIT – 3	8 Hrs

Operator overloading and Type conversion: Defining Operator overloading, Overloading Unary operators, Binary Operators using friend functions and Member functions, Overloading Special operators , Comma operator, new and delete operators, Rules for overloading operators, Type conversion.

Inheritance : Concept of Inheritance, types of inheritance - single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class.

UNIT – 4	7 Hrs

Polymorphism: Pointers, Pointes to Objects, pointers to members and member functions, Pointers to derived classes, virtual and pure virtual functions.

I/O and File Management : Concept of streams, C++ stream classes, Unformatted and formatted I/O, manipulators, C++ File stream classes, File management functions, File modes, Binary and random Files.

UNIT – 5	7 Hrs

Templates : Introduction to templates, function templates and class templates.

Introduction to exception: try-catch throw, multiple catch, catch all, rethrowing exception, user defined exceptions.

Introduction to Standard Template Library: Components of STL - Containers, Algorithms, Iterators, Application of Container classes.
Text Books :   1. Object Oriented Programming with C++ by E Balaguruswamy, 6th Edition, Tata McGraw Hill, 2013.   2. C++ - The Complete Reference by Herbert Schildt, 4th Edition, Tata McGraw Hill, 2015
Reference Books :   1. C++ Primer by Stanley B Lippman, Josee Lajoie, Barbara E Moo, 6th Edition, Addison-Wesley Professional   2. Object-Oriented Programming in C++ by Robert Lafore, 4th Edition, Pearson Education.
e-Books :   1.   https://fac.ksu.edu.sa/sites/default/files/ObjectOrientedProgramminginC4thEdition.pdf   2. http://znc.es/Addison.Wesley.C++%20Primer.By.Stanley%20B.%20Lippman.pdf
MOOCs   1. https://swayam.gov.in/nd1_noc19_cs38/preview   2. https://www.edx.org/course/object-oriented-programming-2

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the basic concepts of object oriented programming with C++.
CO2	Apply the concepts of data abstraction, encapsulation, polymorphism, inheritance, and templates and file handling.
CO3	Identify the usage of reusability, polymorphism and exception handling for solving problems.
CO4	Develop solutions using object oriented programming concepts for a given problem.
CO5	Conduct experiments for the concepts of function overloading, operator overloading, exception handling, templates & file functionalities using modern tools.

Course Title	DIGITAL LOGIC DESIGN				
Course Code	19IS3PCDLD	Credits	3	L-T-P	2-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			24

UNIT – 1	4 Hrs
The Basic Gates: Review of Basic Logic gates, Positive and Negative Logic Combinational Logic Circuits: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs, Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Product-of-Sums Method, Product-of-Sums simplifications, Simplification by Quine-McClusky Method.	

UNIT – 2	5 Hrs
Data-Processing Circuits: Multiplexers, Demultiplexers, 1-of-16 Decoder, Exclusive-or Gates, Encoders, Parity Generators and Checkers, Magnitude Comparator, Programmable Array Logic, Programmable Logic Arrays.	

UNIT – 3	5 Hrs
Flip- Flops: RS Flip-Flops, Gated Flip-Flops, Edge-triggered Flip-Flops, Flip-Flop Timing, JK Master-Slave Flip-Flop, Various Representation of FLIP-FLOPs, Analysis of Sequential Circuits.	

UNIT – 4	5 Hrs
Registers: Types of Registers, Applications of Shift Registers. **Counters:** Asynchronous Counters, Synchronous Counters, Changing the Counter Modulus, Counter Design as a Synthesis problem.	

UNIT – 5	5 Hrs
Design of Synchronous Sequential Circuits: Model Selection, State Transition Diagram, State Synthesis Table, Design Equations and Circuit Diagram, State Reduction Techniques. **Asynchronous Sequential Circuits:** Analysis of Asynchronous Sequential Circuit, Problems with Asynchronous Sequential Circuits, Design of Asynchronous Sequential Circuit.	

Text Books

1. Donald P Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015.

2. R D Sudhaker Samuel: Illustrative Approach to Logic Design, Sanguine-Pearson, 2010.

Reference Books :
1. M Morris Mano: Digital Logic and Computer Design, 10th Edition, Pearson, 2008. 2. Donald D. Givone, Digital Principles and Design, McGraw Hill, 2002.
e-Books :
1. https://bit.ly/2YkwnRe 2. https://bit.ly/2YgpMHr
MOOCs
1. https://swayam.gov.in/nd1_noc19_ee51/preview 2. https://nptel.ac.in/courses/117105080/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend basic logic gates, combinational logic circuits and sequential logic circuits.
CO2	Apply digital logic to simplify boolean equations and functions.
CO3	Design synchronous and asynchronous counters.
CO4	Analyze combinational and sequential logic circuits.
CO5	Prototype synchronous and asynchronous sequential circuits.

Course Title	COMPUTER ORGANIZATION AND ARCHITECTURE				
Course Code	19IS3PCCOA	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	7Hrs

Basic Structures of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance.

Machine instructions and Programs: Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Basic Input Output Operations.

UNIT – 2	7Hrs

Input/output Organization: Accessing I/O Devices, Interrupts, Processor Examples-PENTIUM Interrupt Structure, Direct Memory Access, Buses, Interface Circuits.

UNIT – 3	8Hrs

Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-Operand Multiplication, Fast Multiplication, Integer Division.

UNIT – 4	7Hrs

Basic Processing Unit: Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired, Some Fundamental Control, Basic organization of Micro programmed Control unit and conditional branching.

UNIT – 5	7Hrs

Memory Organization: Memory Hierarchy, Main Memory- RAM & ROM chips, Memory Address Map, Memory connection to CPU, Cache Memory-Associative Mapping, Direct mapping, Set Associative mapping, Writing to cache, Cache Initialization.

Pipelining: Basic Concepts-Role of Cache Memory, Pipeline performance.

Text Books :

1. Carl Hamacher, Computer Organization, 5th Edition, McGraw Hill Publishers.
2. Morris Mano, Computer System and Architecture, 3rd Edition, Pearson Education.

Reference Books :

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson, 2015

2. Computer Organization and Design. The Hardware/Software Interface by David A.Patterson and John L.Hennessy, fifth Edition, Morgan Kaufman Publishers(imprint of Elsevier), 2014

e-Books :
1. https://sites.google.com/site/uopcog/ebooks
2. https://pdfs.semanticscholar.org/562e/1e531727b39ec451afb9347f6860445eaa2c.pdf
3. https://nptel.ac.in/courses/106103068/pdf/coa.pdf

MOOCs
1. https://courses.edx.org/courses/course-v1:MITx+6.004.3x_2+1T2017/course/
2. https://www.udacity.com/course/high-performance-computer-architecture--ud007

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the concepts of basic architecture of a computer, instruction execution, interrupts, bus structures, memory organization, arithmetic unit operations and Pipelining concepts.
CO2	Apply the types of addressing modes, stack operations, subroutines, types of memory mapping, and arithmetic operations and data transfer methods on various problems.
CO3	Analyse instruction set architecture, interface circuits, arithmetic and logic circuits, pipeline performance
CO4	Identify the control signals, types of interrupts, bus structures, memory, arithmetic operations and microcontrollers.
CO5	Make an effective communication and presentation in a team on different processor architecture.

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS				
Course Code	19IC3HSCPH	Credits	01	L-T-P	1-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	1	Total Lecture Hours			13

UNIT – 1	3 Hrs

Introduction to Indian Constitution

Historical Background of the Indian Constitution. Framing of the Indian constitution: Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India, Fundamental Rights and its limitations. Fundamental Duties and their significance. Directive Principles of State Policy: Importance and its relevance. Case Studies.

UNIT – 2	2 Hrs

Union Executive and State Executive

The Union Executive – The President and The Vice President, The Prime Minister and The Council of Ministers. The Union Parliament – Lok Sabha & Rajya Sabha. The Supreme Court of India.

State Executive – The Governors, The Chief Ministers and The Council of Ministers. The State Legislature – Legislative Assembly and Legislative Council. State High Courts.

UNIT – 3	2 Hrs

Election Commission of India, Amendments and Emergency Provisions

Election Commission of India – Powers & Functions – Electoral Process in India. Methods of Constitutional Amendments and their Limitations.

Important Constitutional Amendments – 42nd, 44th, 61st,74th, 76th, 77th, 86th and 91st. Emergency Provisions. Case Studies.

UNIT – 4	3 Hrs

Special Constitutional Provisions/ Local Administration/ Human Rights

Special Constitutional Provisions for Schedule Castes, Schedule Tribes & Other Backward Classes. Women & Children. Case Studies.

Human Rights/values – Meaning and Definitions, Legislative Specific Themes in Human Rights and Functions/ Roles of National Human Rights Commission of India. Human Rights (Amendment Act)2006.

UNIT – 5	3 Hrs

Professional Ethics

Scope and Aims of Engineering Ethics, Responsibilities of Engineers and impediments to responsibilities. Honesty, Integrity and Reliability; Risks – Safety and Liability in Engineering. Case Studies.

Text Books :
1. "An Introduction to Constitution of India and Professional Ethics" by Merunandan K.B. and B.R. Venkatesh, Meragu Publications, 3rd edition, 2011.
2. "Constitution of India & Professional Ethics & Human Rights" by Phaneesh K. R., Sudha Publications, 10th edition, 2016.

Reference Books :
1. "V.N. Shukla's Constitution of India" by Prof (Dr.) Mahendra Pal Singh (Revised), Eastern
   Book Company, Edition: 13th Edition, 2017, Reprint 2019.
2. "Ethics in Engineering" by Martin, W. Mike.,Schinzinger, Roland., McGraw-Hill Education; 4th edition (February 6, 2004) .

e-Books :

1. https://books.google.co.in/books/about/Constitution_of_India_and_Professional_E.html?id=VcvuVt-d88QC
   Constitution of India and Professional Ethics, by G.B. Reddy and Mohd Suhaib, I.K. International Publishing House Pvt. Ltd., 2006.
2. http://www.scribd.com/doc/82372282/Indian-Constitution-M-Raja-Ram-2009#scribd
   Indian Constitution, by M. Raja Ram, New Age International Pvt. Limited, 2009.

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land.
CO2	Analyse the concepts and ideas of Human Rights.
CO3	Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.

Course Title	WEB APPLICATION DEVELOPMENT					
Course Code	19IS3PWWAD	Credits	2	L-T-P		0-0-2
CIE	50 Marks	SEE	100 Marks (50% Weightage)			
Contact Hours / Week	4	Total Lab Hours				48

About the Course: The students should develop websites using modern web technologies. The course will be executed in two cycles and a project work. During Cycle 1, the students would be able to design responsive web portals using HTML, CSS and Bootstrap framework. In Cycle 2, both client and server side scripting will be used to build interactive websites using Session management and databases. In the Project work phase, student will design and develop complete end to end web portals based on requirements and design considerations.

Text Books :
1. Ben Frain, Responsive Web Design with HTML5 and CSS3, 2nd Revised Edition, Packt Publishing Limited, 2015.
2. Ethan Brown, Learning JavaScript, 3rd Edition, Oreilly Publishers, 3rd Edition, 2016.
3. Laura Thomson, Luke Welling, PHP and MySQL Development, 5th Edition, Pearson Education, 2016.

Reference Books :
1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Internet & World Wide Web How to Program, 5/e , Prentice Hall, , 2013.
2. Elisabeth Robson, Eric Freeman, Head First Java Script Programming: A Brain-friendly Guide, Oreilly Publishers, 2014.
3. Robin Nixon, Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5, Shroff Publishers & Distributers Private Limited, 4th Edition, 2015.

e-Books :
1. Elizabeth Castro, Bruce Hyslop, HTML5 and CSS3, 7 th Edition, Peach Pit Press, 2012http://ptgmedia.pearsoncmg.com/images/9780321719614/samplepages/0321719611.pdf.
2. PHP Documentation, https://www.php.net/download-docs.php
3. WebCourse, www.drsvn.com/web.

MOOCs
1. Mathew Yee King, Kate Devlin, Marco Gillies, Mic Grierson, Responsive Web Design, Coursera, University of London, Goldsmiths. https://www.coursera.org/learn/responsive-web-design.
2. Charles Severance, Building Web Applications in PHP, Coursera, University of Michigan, https://www.coursera.org/learn/web-applications-php

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO 1	Apply the knowledge of HTML, CSS and Scripting technologies to develop interactive web applications.
CO 2	Analyze front-end web coding languages to add dynamic content, animation and effects to websites.
CO 3	Identify client side and server side scripting technologies.
CO 4	Design an interactive website(s) with regard to issues of usability, accessibility and Standards.
CO 5	Develop web application in a Team.
CO 6	Create device independent web pages based on user specific requirements and constraints using Integrated Development tools (Webstorm/VS Code/Atom).

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	LINEAR ALGEBRA				
Course Code	19MA4BSLIA	Credits	4	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours		36	

UNIT – 1	11Hrs

SYSTEM OF LINEAR EQUATIONS AND VECTOR SPACES: Elementary row operations, echelon forms, rank of matrix. **System of Linear Equations:** solution of homogeneous equations, consistency of non- homogeneous system of linear equations. Gauss elimination method, LU decomposition method. **Vector spaces**: Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates. **(7L+2T)**

UNIT – 2	9 Hrs

LINEAR TRANSFORMATIONS: Introduction, Linear Mappings, Geometric linear transformation of , Kernel and Image of a linear transformations, Matrix representation of linear transformations, Rank-Nullity Theorem(No proof), Singular and Nonsingular linear transformations, Invertible linear transformations. **(7L+2T)**

UNIT – 3	10 Hrs

EIGENVALUES AND EIGENVECTORS: Introduction, Polynomials of Matrices, Characteristic polynomial, Cayley-Hamilton Theorem, eigenvalues and eigenvectors, eigen spaces of a linear transformation, Diagonalization, Minimal Polynomial, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form, Solving differential equations in Fundamental form. **(7L+3T)**

UNIT – 4	10 Hrs

INNER PRODUCT SPACES: Inner product, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error. **(7L+3T)**

UNIT – 5	8 Hrs

SYMMETRIC MATRICES AND QUADRATIC FORMS: Diagonalization of real symmetric matrices, Orthogonal diagonalization of r eal symmetric matrices, quadratic forms and its classifications, Singular value decomposition. **(6L+2T)**

Text Books :
1. Linear Algebra and its applications, David C. lay, Steven R. lay, Judi J Mc. Donald, 5th Edition, 2015, Pearson Education.
2. Linear Algebra and its applications, Gilbert Strang, 4th edition, 2005, Brooks Cole.

Reference Books :
1. Schaum's outline series-Theory and problems of linear algebra, Seymour Lipschutz,

5th edition, 2012, McGraw-Hill Education

2. Linear Algebra an Introduction, Richard Bronson & Gabriel B. Costa, 2nd edition.

e-Books :

1. https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
2. https://www.math.ucdavis.edu/~linear/linear.pdf

Online Courses and Video Lectures:
1. https://www.coursera.org/learn/linear-algebra-machine-learning
2. https://nptel.ac.in/syllabus/111106051/

COURSE OUTCOMES (COs)
At the end of the course, the student will be able to

CO1	Apply the concepts of Matrices to linear systems and vectors spaces.
CO2	Relate the concepts of Eigen values, Eigen vectors & functions to linear algebra.
CO3	Apply the concepts of inner products to matrix decomposition.

Course Title	DATABASE MANAGEMENT SYSTEM				
Course Code	19IS4PCDBM	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36

UNIT – 1	7 Hrs
The Evolution of Database Systems, Overview of a Database Management System, Outline of Database-System. The Entity-Relationship Data Model, Elements of the E/R Model, Modeling of Constraints, Weak Entity Sets, Basics of the Relational Model, Conversion From E/R Diagrams to Relational Design.	

UNIT – 2	8 Hrs
Defining a Relation Schema in SQL, Set Operations on Relations ,Constraints in SQL: Keys and foreign keys, Database Modifications, Constraints on Attributes and Tuples, Modification of Constraints, An Algebra of Relational operations: Basics of Relational Algebra ,why bags,join operations of bags,Simple Queries in SQL, Queries Involving More Than One Relation, Extended Operators Of Relational Algebra:Duplicate Elimination, aggregation, grouping and outerjoins, Subqueries in SQL, Full-Relation Operations in SQL, Views (Virtual Tables) in SQL.	

UNIT – 3	7 Hrs
An overview of NoSQL, Characteristics of NoSQL, NoSQL storage types, Advantages and Drawbacks of NoSQL, Case Study: Application definition, Requirement Analysis, Implementation using MongoDB, Database Queries, Writing Queries.	

UNIT – 4	7 Hrs
Functional Dependencies, Trivial Functional Dependencies, Computing the Closure of Attributes, Rules About Functional Dependencies, Design of Relational Database Schemas, Mult ivalued Dependencies.	

UNIT – 5	7 Hrs
Transactions in SQL, Concurrency Control, Serial and Serializable Schedules, Conflict-Serializability, Enforcing Serializability by Locks, Locking Systems with Several Lock Modes Introduction to Distributed Databases: Distribution of Data, Distributed Transactions, Data Replication, Distributed Query Optimization.	

Text Books:
1. Database Systems: The Complete Book Hector Garcia-Molina Jeffrey D. Ullman Jennifer Widom,2nd edition.
2. Getting Started with NoSQL by Gaurav Vaish.

Reference Books:

1. Fundamental of Database Systems by Elmasri and Navathe, 6 th Edition, Addison-Wesley, 2011.
2. Database System Concepts by Silberschatz, Korth and Sudharshan, 6 th Edition, McGrawHill, 2015.

e-Books :

1. http://www-inst.eecs.berkeley.edu/~cs186/sp08/
2. http://iips.icci.edu.iq/images/exam/databases-ramaz.pdf
3. Database Management Systems- 2013
   http://www.lincoste.com/ebooks/english/pdf/computers/database_management_systems.pdf.
4. NoSQL:https://bigdata-ir.com/wp-content/uploads/2017/04/NoSQL-Distilled.pdf

MOOCs:

1. https://www.classcentral.com/course/stanford-openedx-db-introduction-to-databases-1006
2. https://cs.stanford.edu/people/widom/DB-mooc.html
3. https://nptel.ac.in/courses/106104135/
4. https://www.edx.org/course/amazon-dynamodb-building-nosql-database-driven-applications

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the fundamentals of database management systems, ER model, relational algebra, SQL, NoSQL, design principles and Transaction management.
CO2	Apply database management concepts, principles, Entity –Relationship model, relational algebra concepts, database design principles and Transaction management to describe DB to given scenario.
CO3	Analyse the concepts of database management principles, Entity –Relationship model, ER to Relational mapping, relational algebra and database design principles.
CO4	Design the given application without anomalies using ER modeling, Normalizations, transaction management properties.
CO5	Synthesize sophisticated queries to extract the information from the given database using SQL and NoSQL.
CO6	Develop and demonstrate Database Management System for real time problem in a deiverse team using appropriate tools.

Course Title	ANALYSIS AND DESIGN OF ALGORITHMS				
Course Code	19IS4PCADA	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36

UNIT – 1	7 Hrs

Fundamentals of Algorithm Analysis: Definition of algorithm, Algorithmic Problem Solving, Framework for Analysis of algorithm efficiency, Asymptotic Notations, Mathematical Analysis of Non recursive algorithms and Recursive algorithms.

UNIT – 2	7 Hrs

Brute Force: Sorting techniques, String Matching, Exhaustive search
Divide and Conquer: Master Theorem, Merge sort, Quicksort.
Greedy Technique: Minimum Spanning tree and its application.

UNIT – 3	8 Hrs

Decrease and conquer: Depth First Search (DFS), Breadth First Search (BFS), Applications of DFS and BFS, Topological Sorting, Algorithms for Generating Combinatorial Objects
Space and Time Trade-offs: Horspool Algorithm, Hashing

UNIT – 4	7 Hrs

Transform and Conquer: Pre-sorting, 2-3 Trees, Heaps and Heapsort
Dynamic Programming: Computing a Binomial Coefficient, Floyd's Algorithm, Knapsack Problem and Memory functions.

UNIT – 5	7 Hrs

Limitations of Algorithm Power: Decision Trees, P, NP and NP-Complete Problems.
Backtracking: N queens problem, Sum of subset problem
Branch and bound: Travelling Salesman problem, Assignment problem

Text Books
1. Introduction to the design and analysis of algorithms, by Anany Levitin, 3rd Edition, Pearson Education, 2011.
2. Computer Algorithms, by Horowitz E., Sahani S., Rajasekharan S., 2nd Edition, Universities Press, 2008.

Reference Books

1. Introduction to Algorithms, Cormen T.H, Leiserson C. E, Rivest R.L, Stein C, 3rd Edition, PHI 2010.
2. Data Structures and Algorithm Analysis in C++, by Mark Allen Weiss, PHI, 2013.

e-Books :

1. https://www.cs.duke.edu/courses/fall08/cps230/Book.pdf
2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf

MOOCs

1. https://www.coursera.org/course/algs4partI
2. https://people.eecs.berkeley.edu/~jrs/61b/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Apply various algorithmic design paradigms to basic computing problems.
CO2	Analyze the time complexity of different algorithms.
CO3	Design efficient algorithms using appropriate algorithm design techniques.
CO4	Conduct experiments to implement algorithms and provide valid conclusions.
CO5	Make effective presentations and documentation to justify the performance of designed algorithms for the computing problem.

Course Title	JAVA PROGRAMMING				
Course Code	**19IS4PCJAV**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**5**	**Total Lecture Hours**			**36**

UNIT – 1	8 Hrs

Introduction to Java: Java's Lineage, The Bytecode, The Java Buzzwords.

Introducing classes: Class fundamentals, Declaring objects, Assigning object reference variables, Introducing methods, Constructors, this keyword, Garbage Collection, A Stack class.

Methods and classes: Overloading methods, Objects as parameters, argument passing, Returning objects.

Inheritance: Basics, Using super, Multilevel hierarchy, When constructors are executed, Method overriding, Dynamic method dispatch, Abstract classes, Using final with inheritance, Object class.

UNIT – 2	7 Hrs

Packages and Interfaces: Packages, Member Access, Importing packages, Interfaces, Default interface methods, Use static methods in an interface.

Exception Handling: Fundamentals, types, Uncaught exceptions, Try and catch blocks, multiple catch, nested try, throw, throws, finally, Creating own exceptions.

UNIT – 3	7 Hrs

Multithreaded programming: Java thread model, The main thread, Creating a thread and multiple threads, Using isAlive() and join(), Thread priorities, Synchronization, Interthread communication.

Type Wrappers, Autoboxing, I/O Basics, Reading console input, Writing console output, Printwriter class, Reading and writing files, closing a file.

UNIT – 4	7 Hrs

Generics: A simple generic example, Generic Class with two type parameters, The General Form of a Generic Class, Bounded types.

String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Changing the Case of Characters Within a String, Joining Strings, StringBuffer.

UNIT - 5	7 Hrs

Collections Framework: Overview, Collection classes - ArrayList Class, LinkedList Class, HashSet Class, TreeSet Class, ArrayDeque Class.

Introducing Swing: The Origin of Swing, Swing Is Built on AWT, Two Key Swing Features, The MVC Connection, Components and Containers, The Top-Level Container Panes, The Swing Packages, A Simple Swing Application, Event Handling, Painting in Swing, Painting Fundamentals, Compute the Paintable Area, A Paint Example.

Text Book

1. Java : The Complete Reference by Herbert Schildt, McGraw-Hill Education, 11th edition 2018.
2. Programming with Java A Primer by E.BalaGuruSwamy, McGraw Hill Education, 6th edition, 2014.

Reference Books

1. Introduction to Java Programming by Y. Daniel Liang, Pearson, 11th edition, 2017
2. Object Oriented Programming with Java: Essentials and Applications by Rajkumar Buyya, Thamarai Selvi, Xing, Tata McGraw Hill Education, 2009

e-Books :

1. http://index-of.co.uk/Hacking-Coleccion/106%20-%20Java%20Programming%20%5B-PUNISHER-%5D.pdf
2. https://www.cs.cmu.edu/afs/cs.cmu.edu/user/gchen/www/download/java/LearnJava.pdf

MOOCS

1. https://www.edx.org/course/introduction-to-java-programming-starting-to-code-with-java
2. https://www.udacity.com/course/object-oriented-programming-in-java--ud283

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the concepts of objects, classes, packages, interfaces, strings, collections and swing.
CO2	Apply the principles of object oriented programming to solve problems.
CO3	Identify the usage of constructs for reusability, abstraction, exception handling and multithreading.
CO4	Develop computer programs to handle runtime errors, concurrency, files, generics and graphical user interface components.
CO5	Conduct experiments to implement various operations on classes and swing.
CO6	Demonstrate coding skills on a competitive programming platform.

Course Title	THEORETICAL FOUNDATIONS OF COMPUTATION				
Course Code	**19IS4PCTFC**	**Credits**	**4**	**L-T-P**	**3-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**5**	**Total Lecture Hours**			**36**

UNIT – 1	8 Hrs

Introduction to Finite Automata: Introduction to Finite Automata, Concepts of Automata Theory, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA) and e-NFA, E-CLOSURES, Equivalence of NFA and DFA.

UNIT – 2	7 Hrs

Regular Expressions and Regular Languages: Relation between Regular Expressions and Regular Languages, Pumping Lemma for regular languages, Equivalence and minimization of regular expression and Finite automata.

UNIT – 3	7 Hrs

Context Free Grammars and Languages: Parse trees, Application of Context Free Grammars, Ambiguity in Grammars, Simplification of Context Free Grammar, Normal Forms – CNF and GNF.

UNIT – 4	7 Hrs

Push Down Automata: Introduction and construction of PDA, Acceptance by final state, empty stack and its conversion. Equivalence of PDA's and CFG's, Non- Deterministic and Deterministic Push Down Automata.

UNIT – 5	7 Hrs

Turing Machines: Introduction to Turing Machine, The Universal Turing machine, Combining Turing machines for complicated tasks. Introduction to undecidable problems, Post-correspondence Problem.

Text Books :
1. Introduction to Automata Theory, Languages and Computation by John E. Hop croft, Rajeev Motwani, Jeffrey D.Ullman: 3rd Edition, Pearson education, 2007.
2. An Introduction to formal Languages and Automata by Peter Linz, Jones & Bartlett Learning , 5 edition, Feb 14,2011.

Reference Books :
1. Introduction to Languages and Automata Theory by John C Martin, 3 Ed, Tata McGraw-Hill, 2009.

| **2.** | Introduction to Theory of Computation, Michael Sipser, Cengage Learning ,3rd edition,2012. |

e-Books :

1. https://mcdtu.files.wordpress.com/2017/03/toc-klp-mishra.pdf
2. https://www.iitg.ernet.in/dgoswami/Flat-Notes.pdf

MOOCs :
1. https://lagunita.stanford.edu/courses/course-v1:ComputerScience+Automata+SelfPaced/about
2. https://www.classcentral.com/course/stanford-openedx-automata-theory-376

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the fundamental concepts of formal languages and automata.
CO2	Apply basic algorithms to solve problems related to the area of theory of computation
CO3	Recognise different computing language classes and their relationship.
CO4	Analyse automata and their power to recognise languages.
CO5	Design grammars and automata for different levels of formal languages.
CO6	Construct and simulate automata using simulation tool.

Course Title	**UNIX SYSTEM PROGRAMMING**				
Course Code	**19IS4PWUSP**	**Credits**	**2**	**L-T-P**	**0-0-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lab Hours**			**48**

Working with UNIX commands Basic Operating System commands, file attributes, file creation and file handling, directories, Processes, Filters such as find, cut, Grep & EGrep, Handling Jobs,SSH.

- Shell scripts Introduction to shell, command substitution, Command Line arguments, Conditional & Looping, Functions, Schedulers.

- Exploring File API's like Open, Close, Read, Write, LSeek, Stat, FStat, fcntl, chmod, chown, file and record locking, etc.

- Directory, Device and FIFO File API's like mkdir, opendir, readdir, rmdir,mknod, mkfifo.

- Implementing basic UNIX commands using API's like mv, cp, ls, ln, etc.

- Programs related to Signals and Signal handling using Signal API's

- Programs on Process creations using API's

- Programs based on Inter process communications using various IPC's.

Sample Projects on topics like Task Management, File Management, Device files management, Schedulers, File transfer using IPC's, Deadlocks resolving, Compression utilities and Directory utilities, creating user defined library functions and API, etc.

Text Books :
1. Sumitabha Das, UNIX Concepts and Applications, Second Edition, TMGH, 2002.

2. Unix System Programming Using C++, by Terrence Chan - Prentice Hall India, 1999.

Reference Books :
1. Advanced Programming in the UNIX Environment, by Stephen A. Rago, W. Richard Stevens,   2nd Edition, Pearson Education / PHI, 2005
2. Linux System Programming, 2nd Edition by Robert Love Publisher: O'Reilly Media, Inc.

e-Books :
1. http://catb.org/~esr/writings/taoup/html/
2. http://oopweb.com/CPP/Documents/DebugCPP/VolumeFrames.html

MOOCs
1. https://www.coursera.org/learn/unix
2. https://www.pluralsight.com/courses/linux-systems-programming
3. https://www.edx.org/course/introduction-linux-linuxfoundationx-lfs101x-1

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Apply API's for implementing UNIX commands, file management and process control
CO2	Analyse System call interface for process management, multitasking programs, IPCS in UNIX
CO3	Design client server communications using IPCS
CO4	Communicate effectively in a team and demonstrate the solution for a given Problem.

Course Title	**MACHINE LEARNING**				
Course Code	**20IS5PCMLG**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**5**	**Total Lecture Hours**			**36**

UNIT – 1	**8 Hrs**

The Machine Learning Landscape: What is Machine Learning? Why use Machine Learning? Types of Machine Learning systems, Main Challenges of Machine Learning, Testing and Validation.

End-to-End Machine Learning Project: Look at the Big Picture, Get the Data, Discover and Visualize the Data to Gain Insights, Prepare the Data for Machine Learning Algorithms, Data Cleaning, Feature Scaling, Select and Train a Model, Training and Evaluating on the Training Set, Fine-Tune Your Model

UNIT – 2	**8 Hrs**

Classification: Training a Binary Classifier, Performance Measures, Multiclass Classification, Error Analysis.

Training Models: Linear Regression, Gradient Descent, Polynomial Regression, Regularized Linear Models, Logistic Regression

UNIT – 3	**6 Hrs**

Decision Trees: Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Gini Impurity or Entropy? Regularization Hyperparameters

UNIT – 4	**8 Hrs**

Ensemble Learning and Random Forests: Voting Classifiers, Bagging and Pasting, Random Forests, Boosting

Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA

UNIT - 5	**6 Hrs**

Unsupervised Learning Techniques: Clustering, k-means, Limits of K-Means, using clustering for Image segmentation, Using Clustering for Preprocessing, DBSCAN.

Text Books :

1. "Hands-On Machine Learning with Scikit-Learn & Tensor Flow", 2nd Edition, Aurelian Geron.
2. "Python Machine Learning- Third Edition" by Sebastian Raschka and Vahid Mirjalili

Reference Books :
1. Introduction to Machine Learning 3rd Edition by Ethem Alpaydin, The MIT Press ,3rd Edition 2014.
e-Books :
1. https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/
MOOCS
1. https://swayam.gov.in/nd1_noc19_cs52/preview   2. https://www.coursera.org/learn/machine-learning/   3. https://nptel.ac.in/courses/106106139/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Acquire knowledge on basic concepts of Machine Learning techniques such as supervised and unsupervised learning.
CO2	Apply the concepts of Classification, Regression, Clustering and Dimensionality reduction algorithms to a given problem.
CO3	Identify Machine Learning techniques suitable for a given problem.
CO4	Design and Develop applications using Machine Learning techniques.
CO5	Demonstrate the implementation of Machine Learning algorithms using modern tools.
CO6	Communicate effectively in a team and investigate on the topics related to Machine learning algorithms.

Course Title	CLOUD COMPUTING				
Course Code	20IS5PCCLC	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			24

UNIT – 1	6 Hrs

Introduction to Cloud Computing, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud.

UNIT – 2	4 Hrs

Virtual Machines Provisioning and Migration Services: Introduction and Inspiration, Background and Related Work, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, VM Provisioning and Migration in Action.

UNIT – 3	4 Hrs

Cloud Application Design, Introduction, Design Considerations for Cloud Applications, Reference architecture for cloud applications, Cloud Application Design Methodologies.

UNIT – 4	4 Hrs

Introducing Google Cloud Platform, Google Cloud Architecture, GCP compute services, GCP storage services, Cloud Storage Cloud Bigtable, Cloud SQL and Cloud Spanner, Cloud Datastore.

UNIT - 5	6 Hrs

Introduction to Security in the Cloud, Security Concepts, Security is implemented in layers ,Securing People, Principle of least privilege, Separation of duties, To grant people access to your projects, add them as members and assign them one or more roles, Use organizational policies and folders to simplify securing environments and managing resources, Identity-Aware Proxy simplifies authorization to Google Cloud applications and VMs, Identity Platform provides authentication as a service, Google Cloud provides server-side encryption of data at rest by default.

Text Books :

1. Cloud Computing-Principles and paradigma, Rajkumar Buyya, James Borberg, Andrzej Goscinski, 2017.
2. Cloud computing, A Hands On Approach, Arshdeep Bahga, Vijay Madisetti, 2016.
3. https://storage.googleapis.com/cloud-training/gcpfcoreinfra/4.1/Student/GCP-Fund-Module-1-Introducing-Google-Cloud-Platform.pdf
4. https://storage.googleapis.com/cloud-training/gcpfcoreinfra/4.1/Student/GCP-Fund-Module-4-Storage-in-the-Cloud.pdf

5.	https://d3c33hcgiwev3.cloudfront.net/haO6TpU5QJqjuk6VOTCafQ_29e7da728d3e4b eebb5a7bd87c55834b_file-module-slides-8-security.pdf?Expires=1596672000&Signature=gfbAJPaJmlJJAyUzVY7nVFXd2NpD yQyFK~pw4Lj69CHSSh4xRF4M5KA8DlG0OPSM-i~g8gh1j1RccCVjiB-4aCwGJmoW-5gmMIF7wWdsam2WyjDXwDwXN7iCI7N6GN-uXDqLg81BSiIJQkNfjN6lwr9whAIt0Bbvifrf6rO8R9k_&Key-Pair-Id=APKAJLTNE6QMUY6HBC5A

Reference Books :

1. Distributed and cloud computing from parallel processing to internet of things, Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Elsevier, Morgan Kaufmann.

2. Cloud computing, Theory and Practice, Dan C. Marinesco, 2013 Elsevier Inc.

e-Books :

1. https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnx kcmdtYnVrY3xneDo0YzkwNDkwYWFkOGJhMDE

2. https://www.pdfdrive.com/secure-cloud-computing-d26598533.html

MOOCS:

1. https://swayam.gov.in/nd1_noc20_cs55/preview

2. https://www.coursera.org/browse/information-technology/cloud-computing

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand computing systems, cloud-paradigms, security and privacy issues in cloud environments.
CO2	Apply the different computing principles using cloud environment.
CO3	Analyse the importance of virtualization in distribute computing and how this has enabled the development of cloud computing.
CO4	Design cloud environment for different real time requirements.
CO5	Implement virtualization and cloud scenarios.
CO6	Develop applications on cloud environments.

Course Title	COMPUTER NETWORKS - 1				
Course Code	20IS5PCDCN	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)
Contact Hours / Week	5	\multicolumn{2}{c|}{Total Lecture Hours}		36

UNIT – 1	9 Hrs

Introduction And Overview: Growth Of Computer Networking, Protocol Suites And Layering Models, How Data Passes Through Layers, Headers And Layers, ISO and the OSI Seven Layer Reference Model.

Information Sources And Signals: Analog And Digital Signals, Converting A Digital Signal To Analog, The Bandwidth Of A Digital Signal, Line Coding, Manchester Encoding Used In Computer Networks, Converting An Analog Signal To Digital, The Nyquist Theorem and Sampling Rate.

Transmission modes: Serial Transmission, Parallel Transmission, Asynchronous Transmission, Synchronous Transmission, Isochronous Transmission, Simplex, Half-Duplex and Full-Duplex Transmission

UNIT – 2	7 Hrs

Data Link Layer: Design issues, Error detection and correction, Elementary data link protocols, Sliding window protocols.

UNIT – 3	6 Hrs

Medium access control sublayer: Channel allocation problem, Multiple access protocols, Ethernet, Ethernet Physical layer, Ethernet Sub-MAC layer, Wireless LAN: 802.11-architecture, Protocol stack, MAC sublayer protocol, frame structure.

UNIT – 4	7 Hrs

Internetworking Concepts, Architectures, and Protocols: Internetworking, The IP Addressing Scheme, The IP Address Hierarchy, Classes of IP addresses, Subnet and Classless Addressing.

Data Forwarding: Connectionless Service, Virtual Packets, The IP Datagram Header Format, Forwarding An IP Datagram, Network Prefix Extraction and Datagram Forwarding, Longest Prefix match, Destination Address and Net-Hop Address, Best-Effort Delivery, IP Encapsulation, MTU and Datagram Fragmentation and Reassembly.

UNIT - 5	7 Hrs

Support Protocols and Technologies: The Address Resolution Protocol (ARP), ARP Message Format, Internet Control Message Protocol (ICMP), ICMP Message Format and Encapsulation, Dynamic Host Configuration Protocol, DHCP Protocol Operation and Optimizations, DHCP Message Format, Network Address Translation (NAT), NAT Operation and Private Addresses.

The Future IP(IPV6): IPV6 Features, IPV6 Datagram Format, IPV6 Base Header Format, IP Addressing.

Internet Routing and Routing Protocols: Static VS Dynamic Routing, The two types of Internet Routing Protocols, Routes and Data Traffic, The Border Gateway Protocol (BGP), The Routing Information Protocol(RIP),RIP Packet Format, The Open Shortest Path First Protocol.

Text Books :

1. Douglas E. Comer: Computer Networks and Internets, Pearson Education, 5th Edition.
2. Andrew S Tannenbaum and David J Wetherall: Computer Networks, Pearson, 5thEdition,2014

Reference Books :

1. Alberto Leon-Garcia and IndraWidjaja: Communication Networks - Fundamental Concepts and Key architectures, 2nd Edition Tata McGraw-Hill, 2004.
2. Behrouz A. Forouzan, Data Communication and Networking, McGraw-Hill,5th Edition.
3. Fred Halshall : Computer Networking and the Internet, Pearson Education,5th Edition.

e-Books :

1. http://www.e-booksdirectory.com/details.php?ebook=3502

2. http://www.freetechbooks.com/data-communication-and-networks-f31.html

MOOCS:

1. https://www.coursera.org/learn/data-communication-network-services
2. https://www.coursera.org/learn/fundamentals-network-communications
3. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-263j-data-communication-networks-fall-2002/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Acquire knowledge about the various principles of communication.
CO2	Apply the data link layer and Network Layer protocols to solve real life problems.
CO3	Analyse the protocols used in MAC and IP layer.
CO4	Design network using internetworking concepts and protocols.
CO5	Conduct experiments on network design, packets transmission and protocols working using modern engineering tool.

Course Title	SOFTWARE ENGINEERING AND OBJECT ORIENTED MODELING DESIGN				
Course Code	20IS5PCSEO	Credits	4	L-T-P	3-1-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36

UNIT – 1	6 Hrs

Introduction: Software Engineering -What Is Software Engineering? Software Engineering Concepts, Software Engineering Development Activities, Managing Software Development, ARENA Case Study..

UNIT – 2	7 Hrs

Modeling with UML :An Overview of UML, Modeling Concepts, A Deeper View into UML, Use Case Diagrams, Interaction Diagrams, State Machine Diagrams, Activity Diagrams, ARENA Case Study.

UNIT – 3	8 Hrs

Requirement Elicitation: An Overview of Requirements Elicitation, Requirements Elicitation Concepts- Functional requirements; Non-functional requirements; completeness, consistency, clarity and correctness; realism, verifiability and traceability; green filed engineering, re-engineering and interface engineering, ARENA Case Study

UNIT – 4	7 Hrs

Testing: An Overview of Testing, Testing Concepts: Faults, Erroneous states, and failures; Test cases, test stub and drivers; corrections, Testing Activities: Component inspection; usability testing; unit testing; integration testing; system testing.

UNIT - 5	8 Hrs

Agile software development: Agile methods, Agile development techniques, agile project management, Scaling Agile methods. Project Management: Risk Management, Managing people, Teamwork. Project Planning: Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.

Text Books:

1. Object-Oriented Software Engineering-Using UML, Patterns, and Java™,Third Edition-Bernd Bruegge & Allen H. Dutoit
2. Software Engineering by Ian Sommerville, 10e , Pearson.

Reference Books:

1. Software Engineering- A Practitioner's approach, 8th edition, by Roger S. Pressman and Bruce R. MAXIM
2. Software Engineering with UML by Bhuvan Unhelkar, CRC Press
3. Object –oriented modeling and design with UML, 2nd edition by Michael Blaha and James Rumbaugh

4.	Object-oriented analysis and design with applications , 3rd edition by Booch, Jacobson and Rumbaugh

e-Books :

1. https://www.ece.rutgers.edu/~marsic/books/SE/book-SE_marsic.pdf
2. https://friendkvvk.files.wordpress.com/2015/08/friendkvvk-ooad.pdf

MOOCS:

1. https://www.edx.org/learn/software-engineering
2. https://www.coursera.org/courses?query=software%20engineering
3. https://nptel.ac.in/courses/106105153/
4. https://www.coursera.org/courses?query=object%20oriented%20design

Tutorials:

1. http://vlabs.iitkgp.ernet.in/se/
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/sw_engg/labs/index.php
3. https://www.igdtuw.ac.in/6/stories/lab%20manuals-it/OOSE%20Lab%20Manual.pdf

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the basic concepts of software engineering principles, elements of UML language.
CO2	Determine software requirements, UML mapping principles, testing methods for user scenario and management of projects.
CO3	Analyze requirement elicitation process, UML design models.
CO4	Design UML models and test suites for stakeholders. Here
CO5	Demonstrate diagraming, requirement phases, test scenarios using suitable tools.

Course Title	ENTREPRENEURSHIP,MANAGEMENT AND IPR				
Course Code	20IS5HSEMR	Credits	2	L-T-P	2-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	2	Total Lecture Hours			24

UNIT – 1	4 Hrs

The entrepreneurial perspective: The nature of entrepreneurship, How Entrepreneurs Think, Entrepreneur background and characteristics. Reasons for interest in corporate entrepreneurship, Generation of new entry opportunity, Entry strategy for new entry exploitation, Risk reduction for new entry exploitation.

UNIT – 2	5 Hrs

Innovation, Opportunity recognition, Product planning and development process, E-commerce and business start-up, International v/s domestic entrepreneurship, Entrepreneurial entry strategies, Legal issues in setting up the organization.

UNIT – 3	6 Hrs

Writing the business plan, Implementing the business plan, Marketing research for the new venture, Preparing the marketing plan, Characteristics of a marketing plan, steps in preparing marketing plan, Legal forms of business, S-Corporation, Limited Liability Company, Building the management team and a successful organization culture, Operating and capital budgets, Venture capital.

UNIT – 4	5 Hrs

Management: Management-importance, definition, functions or the process, Managerial skills & effectiveness, Management and administration, Importance of planning, Types of plans, Steps in planning, Strategic planning process, Meaning & types of decisions.

UNIT - 5	4 Hrs

IPR: Introduction, Meaning, Relevance, Business Impact, Protection of Intellectual Property, Bio-diversity and IPR , Patents, Trademarks, Copyrights, Licensing. Competing Rationales for Protection of Intellectual Property Rights, Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention.

Text Books:

1. Entrepreneurship by Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, 10th edition , McGrawHill Education
2. Intellectual Property Rights-Law and Practice by "The Institute Secretaries of India"
3. Principles of Management by P.C. Tripathi and P N Reddy

Reference Books:

1. Management and Entrepreneurship (Kindle Edition) by T Krishna Rao, Naidu, N V R
2. Fundamentals for Becoming a Successful Entrepreneur: From Business Idea to

Launch and Management by Malin Brannback Alan Carsrud ©2016 |Pearson FT Press

3. An introduction to Intellectual Property Rights By M. Venkataraman.
4. Entrepreneurship management by Dr. P.V.V Satyananarayana 2018.

e-Books :

1. Principles of management –open stax "Principlesofmanagement-OP_rU5O3X1.pdf"
2. https://open.umn.edu/opentextbooks/textbooks/principles-of-management-2019
3. https://openstax.org/details/books/principles-management?Book%20details
4. https://open.umn.edu/opentextbooks/textbooks/problem-solving-in-teams-and-groups

MOOCS:

1. https://www.udemy.com/courses/business/entrepreneurship/
2. https://www.coursera.org/courses?query=intellectual%20property
3. https://nptel.ac.in/courses/110/105/110105067/
4. https://swayam.gov.in/nd1_noc20_hs66/preview

Resources :

5. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000023MA/P001403/M016044/ET/1465204830Module-24Quadrant-I.pdf
6. https://www.fingerprintforsuccess.com/blog/entrepreneur-resources
7. https://managementhelp.org/startingorganizations/starting-business.htm
8. https://link.springer.com/content/pdf/10.1007/s11365-014-0321-8.pdf

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Obtain an understanding of entrepreneurial characteristics, business ideas, IPR, Management & administration.
CO2	Recognize opportunities by applying ideas for product development, Marketing & Management.
CO3	Review strategic planning for entrepreneurial management and legal forms of business.
CO4	Develop business plans based on product and services in line with the target market.
CO5	Examine IPR, Patents, Trademarks, Copyrights and Licensing.
CO6	Prepare documents and communicate effectively on entrepreneurial ventures with IPR Policies and opportunities.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**MOBILE APPLICATION DEVELOPMENT**				
Course Code	**20IS5PWMAD**	**Credits**	**2**	**L-T-P**	**0-0-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**
Contact Hours / Week	**4**	\multicolumn{2}{c}{**Total Lab Hours**}		**48**

Pre-requisite: Java Programming

I. Cycle -1

1. Programs based on Android Components, Intents and Layouts.

- Overview of Android Architecture, Android Activity Life Cycle.
- Android Widgets: UI development in Android, Working with Button, TextView, EditText, AutoCompleteTextView, DatePicker, TimePicker, Toast,CustomToast, ToggleButton, Checkbox, Custom CheckBox, RadioButton, DynamicRadioButton CustomRadioButton, AlertDialog, ProgressBar, SeekBar
- Layout Manager: Linear Layouts, Relative Layouts, Coordinator Layouts.
- ListView, RecyclerViews, Spinner, Custom view and drawing custom shapes on Canvas.
- Intents: Explicit and Implicit Intents
- Implementation based on android animation.
- Overview of UX Design

2. Programs based on Android Menu, Android Fragments and Android Service.

- Android Menu: Options Menu, Context Menu, Popup Menu.
- Android Fragments: Android Fragment Lifecycle
- Android Service: Started and Bound

II. Cycle-2

- Programs based on Android Shared Preferences primitives.
- Programs based on SQLite to store and fetch the data from the database application
- Implementation based on android integration with google map.
- Networking with Android using Retrofit/Volley.

III. Projects on App Development.

Text Books :

1. RetoMeier, Professional Android 4 Application Development, Wiley India, (Wrox).
2. James C Sheusi, Android Application Development for Java Programmers, Cengage Learning.
3. Wei-MengLee, Beginning Android 4 Application Development, Wiley India (Wrox).

Reference Books :

1. Pro Android 5, Dave MacLean, SatyaKomatineni and Grant Allen, Apress, 2015.
2. "The Android Developer's Cookbook: Building Applications with the Android SDK" by James Steele, Nelson To, Addison-Wesley Professional.

e-Books :

1. https://www.tutorialspoint.com//android/android_tutorial.pdf
2. https://www.techotopia.com/pdf_previews/AndroidStudio40EssentialsPreview.pdf

MOOCS

1. https://www.coursera.org/learn/aadcapstone
2. https://www.udemy.com/course/learn-android-application-development-y/
3. https://www.udemy.com/course/complete-android-n-developer-course/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the basics of Android development framework and its functionalities.
CO2	Apply the knowledge of android user interfaces, menus, fragments and service for a given problem.
CO3	Analyze packages, project libraries and services to obtain a framework for solving problems in development of mobile applications.
CO4	Implement the code patterns with android concepts, common controls, mapping packages, GUI interactive interfaces, Shared Preferences primitives, serverless database SQLite, integration and networking to arrive at valid conclusions.
CO5	Design mobile Apps to provide solutions for real world problems in a team.
CO6	Demonstrate the real-world application in a team with standard documentation.

Course Title	INTERNET OF THINGS				
Course Code	20IS5PEIOT	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			24

UNIT – 1	5 Hrs

Introduction to Internet of Things: Introduction: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT Protocols, Logical Design of IoT: IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication protocols, Communication Protocols, Embedded Systems, IoT Levels and Deployment Templates.

IoT Applications: Introduction, Home Automation, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Smart Cards, Tracking, Surveillance system, Environment, Energy, Retail, Logistics, Agriculture, Industry and Health care and Lifestyle .

UNIT – 2	5 Hrs

Prototyping IoT Objects Using Microprocessor/Microcontroller Working principles of sensors and actuators – Setting up the board - Programming for IOT – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, Wi-Fi, Ethernet, Zigbee, RFID, NFC.Case Study and IoT Application Development: IoT applications in home- infrastructures- security-Industries- IoT electronic equipment.. Use of Big Data and Visualization in IoT-Industry 4.0 concepts - Sensors and sensor Node –Interfacing using Raspberry Pi/Arduino- Web Enabled Constrained Devices.

UNIT – 3	5 Hrs

Writing Code: building a program and deploying to a device, writing to Actuators, Blinking Led, Reading from Sensors, Light Switch, Voltage Reader, Device as HTTP Client, HTTP, Push Versus Pull Pachube, Netduino,

UNIT – 4	5 Hrs

Sending HTTP Requests—The Simple Way, Sending HTTP Requests— The Efficient Way HTTP: Device as HTTP Server, Relaying Messages to and from the Netduino, Request Handlers, Web Html, Handling Sensor Requests, Handling Actuator Requests

Going Parallel: Multithreading, Parallel Blinker, prototyping online components, using an API, from prototypes to reality, business models, ethics, privacy, disrupting control, Crowdsourcing.

UNIT - 5	4 Hrs

Edge Computing: Introduction, Key benefits of edge for IOT, Unique Requirements of Edge for the IoT,EdgeUse Cases for IoT Edge,Security.

Text Books:

1. Adrian McEwen and Hakim Cassimally, ―Designing the Internet of Things‖, John

Wiley & Sons, 2013.
2. Cuno Pfister, ―Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud‖, Maker Media, 2011.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT,2014.

Reference Books

1. Internet of Things from Versa Technology

e-Books :

1. https://www.iotforall.com/free-intro-ebook-on-the-internet-of-things/

MOOCS

1. https://www.coursera.org/specializations/internet-of-things
2. https://nptel.ac.in/courses/106/105/106105166/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand characteristics such as design,communication model,prototyping and enabling technologies required to develop application of IOT.
CO2	Apply in-depth knowledge of Internet of Things in Identifying the appropriate sensors and actuators with microcontrollers and porting the data to cloud,web site for given applications.
CO3	Identify the appropriate sensors and actuators to solve a given use-case.
CO4	Conduct experiments using modern tools like arduino boards and sensors,actuators, and related softwares to solve given problems.
CO5	Design and develop IOT applications for solving real world problems.
CO6	Communicate effectively in a team and investigate on the topics related to IOT.

Course Title	ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT				
Course Code	20IS5PERPA	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			24

UNIT – 1	5 Hrs

Introduction to RPA: What is RPA?, Why RPA?, Automation Vs RPA, Programming Constructs of RPA, Types of Robots in RPA, Benefits of RPA, RPA development Methodologies, RPA Process.

The User Interface: Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables -Number Variables - Array Variables - Date and Time Variables - Data Table Variables – Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces.

UNIT – 2	6 Hrs

RPA Control Flow and Activities

Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow – Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity -The Switch Activity - The While Activity - The For Each Activity - The Break Activity.

UNIT – 3	4 Hrs

Data Manipulation

Data Manipulation Introduction - Scalar variables, Collections and Tables – Text Manipulation - Data Manipulation - Gathering and Assembling Data.

UNIT – 4	5 Hrs

Advanced Automation Concepts and Techniques

UI Interaction, Desktop and Web recording, Web scraping, Data scrapping, Types of selectors, Image and Text Automation, Data Tables, Excel and PDF operations.

UNIT - 5	4 Hrs

Exception Handling and Orchestration

Debugging Tools, Exception Handling, Types of Exceptions, Workflow Designs, Catching Errors Mechanisms, Introduction to Orchestrator, Process and Robots in Orchestrator, Working with Orchestrator.

Text Books :

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

Reference Books :

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: A Primer, Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant.
3. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.

e-Books :

1. https://www.uipath.com/rpa/robotic-process-automation.

MOOCS

1. https://www.uipath.com/rpa/academy/training
2. https://www.uipath.com/developers/guides-and-resources
3. https://www.uipath.com/developers/video-tutorials
4. https://academy.uipath.com/learn

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Describe RPA, where it can be applied and how its implemented.
CO2	Apply various control and activity flow mechanisms that bound the automation process.
CO3	Perform data manipulation operations and exception handling mechanisms.
CO4	Independently design and create robots for business processes for automating desktop and web applications.
CO5	Implement Orchestration process for automating robots.

Course Title	DATA MINING				
Course Code	**20IS5PEDMG**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lecture Hours**			**24**

UNIT – 1	5 Hrs

Data mining tasks, Data: Types of Data, **Data Quality**: Measurement and data collection issues, **Data Pre-processing**, Measures of Similarity and Dissimilarity.

UNIT – 2	5 Hrs

Classification: Preliminaries, General Approach to Solving Classification Problem, **Decision Tree Induction:** Working, building, methods for expressing attribute test conditions, measures for selecting the best split, algorithm for decision tree induction, characteristics of decision tree induction, Evaluating the performance of a classifier, Rule Based Classifiers, Nearest-Neighbor Classifiers, Bayesian Classifiers: Using Bayes theorem for classification, Naïve Bayes classifier.

UNIT – 3	4 Hrs

Association analysis: Problem Definition, Frequent Itemset Generation, Rule Generation, Compact Representation of Frequent Itemsets, FP-Growth Algorithm, Evaluation of Association Patterns: Objective measure of interestingness.

UNIT – 4	5 Hrs

Cluster Analysis: Overview, K-means: Basic algorithm, additional issues, Bisecting K-means, Agglomerative hierarchical clustering, DBSCAN, **Cluster evaluation:** Unsupervised cluster evaluation using cohesion and separation, proximity matrix, evaluation of hierarchical clustering, Supervised measures of cluster validity.

UNIT - 5	5 Hrs

Cluster Analysis-Additional Issues and Algorithms: Characteristics of data, Clusters and clustering algorithms, Fuzzy clustering, Density based clustering; Graph based clustering: Sparsification, MST, OPOSSUM, Chameleon, Shared nearest neighbor similarity, Scalable Clustering Algorithms.

Text Books :

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Anuj Karpatne and Vipin Kumar, Pearson Education, 2016.

Reference Books:

1. Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, 3rd Edition, Morgan Kaufmann Publishers, Elsevier, 2012.

2.	Introduction to Data Mining with Case Studies, G. K. Gupta, PHI, 3rd Edition, 2014.

e-Books :

1. Data Mining and Analysis: Fundamental Concepts and Algorithms, Mohammed J Zaki and Wagner Meira Jr.,
   https://repo.palkeo.com/algo/information-retrieval/Data%20mining%20and%20analysis.pdf
2. The Handbook of Data Mining, Nong Ye,
   http://read.pudn.com/downloads159/ebook/710349/5GreatMatlabBooks/HandbookOfData Mining.pdf
3. Data Mining, Practical Machine Learning Tools and Techniques, Ian H Witten and Eibe Frank,
   ftp://ftp.ingv.it/pub/manuela.sbarra/Data%20Mining%20Practical%20Machine%20Learning %20Tools%20and%20Techniques%20-%20WEKA.pdf

MOOCS

1. Mining Massive Datasets, https://www.edx.org/course/mining-massive-datasets
2. Data Mining Specialization, https://www.coursera.org/specializations/data-mining

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the concepts of data, classification, association and cluster analysis.
CO2	Apply the concepts of pre-processing, classification, clustering.
CO3	Analyse the usage of measures of similarity and dissimilarity, OLAP and multidimensional data analysis, classification and clustering.
CO4	Identify the concepts of association, classifier and clustering algorithms.
CO5	Synthesize clustering and classification mining techniques.

Course Title	ADVANCED PYTHON PROGRAMMING					
Course Code	20IS5PEAPP	Credits	3	L-T-P	2-0-1	
CIE	50 Marks	SEE	100 Marks (50% Weightage)			
Contact Hours / Week	4	Total Lecture Hours			24	

UNIT – 1	4 Hrs
Files: File Operations, Files and Streams, Creating a File, Reading From a File, Iterating Through Files, Seeking, Serialization.	
UNIT – 2	**4 Hrs**
Databases: How to Use a Database, Working With a Database , Using SQL to Query a Database, Python and SQLite, Creating an SQLite DB, Pulling Data from a DB, SQLite Database Files.	
UNIT – 3	**6 Hrs**
NumPy: The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, and Everything In Between, Computation on Arrays: Broadcasting, Comparisons, Masks, and Boolean Logic, Fancy Indexing, Sorting Arrays.	
UNIT – 4	**4 Hrs**
Introduction to Pandas: Loading your first data set, Looking at columns, rows, and cells, Creating your own data, The Series, The DataFrame.	
UNIT - 5	**6 Hrs**
Data Manipulation with Pandas: Operating on Data in Pandas, Handling Missing Data, Combining Datasets: Concat and Append, Merge and Join, Aggregation and Grouping.	

Text Books:

1. **Learning to Program using Python** by Cody Jackson, Second Edition, 2014.

2. **Pandas for Everyone: Python Data Analysis** by Daniel Y. Chen, First Edition, Pearson, 2018.

3. **Python Data Science Handbook** by Jake VanderPlas, O'Reilly, 2017

Reference Books :

1. **Programming Python**, Mark Lutz, O'Reilly Media, Edition 2010.

2. **MySQL for Python,** Albert Lukaszewski, 2010.

3. **Hands-On Data Analysis with Pandas** by Stefanie Molin, Packt, 2019.

e-Books :

1. http://www.onlineprogrammingbooks.com/learning-program-using-python/

2. https://www.pdfdrive.com/python-for-data-analysis-data-wrangling-with-pandas-numpy-and-ipython-e158189564.html

MOOCS:

1. https://www.coursera.org/learn/python

2. https://www.coursera.org/learn/data-analysis-with-python#about

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the usage of files, databases and data analysis tools like NumPy, Pandas.
CO2	Apply the programming constructs, operations and data analysis tools on a chosen data set.
CO3	Analyse data in Python using multidimensional array in NumPy, apply data frames in Pandas.
CO4	Design solutions in teams for real time societal issues with an aim to import, clean, enrich, transform and output the analysis of large dataset.
CO5	Conduct experiments using modern Python tools.

Course Title	ADVANCED DATA STRUCTURES AND ALGORITHMS				
Course Code	20IS5PEADS	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	9 Hrs

Balanced Search Trees: B-Trees, Skip lists
Tree structures for Set of Intervals: Interval trees and Segment trees
Data Structures for String: Tries, Suffix trees

UNIT – 2	7 Hrs

Heaps: Leftist Heap, Binomial heaps, Operations on binomial heaps. Structure of Fibonacci Heaps, Mergeable heap operations.

UNIT – 3	7 Hrs

Dynamic Programming: Matrix-chain multiplication, Longest common subsequence, Optimal Binary Search Trees.
Greedy Algorithms: An Activity selection problem, Huffman codes.

UNIT – 4	6 Hrs

String-Matching Algorithms: Rabin - Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm.

UNIT - 5	7 Hrs

Graph Algorithms: Bellman - Ford Algorithm, Flow networks and Ford-Fulkerson method
Number -Theoretic Algorithms: GCD, Modular Arithmetic, The Chinese remainder theorem.

Text Books:

1. **Advanced Data Structures** by Peter Brass, First Edition, Cambridge university Press, 2008.
2. **Introduction to Algorithms** by T. H Cormen, C. E. Leiserson and R. L. Rivest, Third Edition, Prentice Hall India, 2009.

Reference Books:

1. **Data Structures and Algorithms Analysis in C++** by Mark Allen Weiss, 4th Edition, Pearson, 2014.

2. **Data Structures Using C and C++** by Yedidyah, Augenstein, Tannenbaum, 2nd Edition, Pearson Education, 2003.

e-Books :

1. Data Structures and Algorithms by John Bullinaria, March 2019
https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf
2. Algorithms by Jeff Erickson,
https://jeffe.cs.illinois.edu/teaching/algorithms/book/Algorithms-JeffE.pdf

MOOCS

1. https://www.coursera.org/specializations/data-structures-algorithms
2.https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-851-advanced-data-structures-spring-2012/index.htm

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Apply principles of advanced Data Structures and Algorithm design techniques for solving complex problems.
CO2	Analyse and develop operations on advanced non-linear data structures.
CO3	Analyse the time complexity of different algorithms and its suitability to complex problems.
CO4	Design solutions to computing problems using appropriate data structures and algorithm design techniques.
CO5	Demonstrate data structure and algorithms coding skills on a competitive programming platform.

Course Title	**COMPILER DESIGN**				
Course Code	**20IS5PECDN**	**Credits**	**3**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**3**	**Total Lecture Hours**			**36**

UNIT – 1	**6 Hrs**
Introduction to Compilers –Lexical Analysis Language Processors, The structure of a Compiler, The Science of building a Compiler, Applications of Compiler Technology, The role of the Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, Design of a Lexical-Analyzer Generator.	
UNIT – 2	**8 Hrs**
Syntax Analysis I Introduction, writing a grammar, Top-Down Parsing, Bottom-Up Parsing.	
UNIT – 3	**7 Hrs**
Syntax Analysis II Introduction to LR parsing: Simple LR, More Powerful LR Parsers, Syntax-Directed Translation: Syntax-Directed Definitions, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes.	
UNIT – 4	**7 Hrs**
Intermediate Code Generation Variants of Syntax Trees, Three-Address Code, Translation of Expressions, Control Flow, Backpatching.	
UNIT - 5	**8 Hrs**
Code Generation Issues in the Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, A Simple Code Generator.	

Text Books:

1. Alfred V. Aho, Jeffrey D Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education Asia, second edition.

Reference Books:

1. Jean Paul Tremblay, Paul G Serenson, "The Theory and Practice of Compiler Writing", BS Publications, 2005

2. Dhamdhere, D. M., "Compiler Construction Principles and Practice", 2nd edition, Macmillan India Ltd., New Delhi, 2008

e-Books :

1. Basics of Compiler Design
   http://hjemmesider.diku.dk/~torbenm/Basics/basics_lulu2.pdf
2. Compiler Design in C
   https://holub.com/goodies/compiler/compilerDesignInC.pdf

MOOCS

1. Compilers - https://online.stanford.edu/courses/soe-ycscs1-compilers
2. Introduction to Compiler Construction and Design -
   https://www.udemy.com/course/introduction-to-compiler-construction-and-design/
3. Learn Compiler Construction & Design From Scratch -
   https://www.udemy.com/course/introduction-to-compiler-construction-design/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the structure and techniques used in compiler construction.
CO2	Understand the basic data structures used in compiler construction such as abstract syntax trees, symbol tables, three-address code and stack machines .
CO3	Apply parsing technique to parse strings, syntax directed translation rules for grammars and code generation algorithms.
CO4	Analyze the lexical, syntactic and code generation into meaningful phases for a compiler to undertake language translation.
CO5	Design a simple compiler for customized programming statements.

Course Title	ARTIFICIAL INTELLIGENCE				
Course Code	20IS5PEAIS	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	7 Hrs
Introduction: What is AI? **Intelligent Agents:** How agent should act, Structure of Intelligent Agents, Environments **Problem Solving:** Formulating problems, Example problems **Uniformed-search strategies:** Breadth-First Search, Uniform Cost Search, Depth-First Search, Depth Limited Search, Iterative Deepening Search.	

UNIT – 2	8 Hrs
Heuristic Search Strategies: Generate-and-Test, Hill Climbing, Best-first Search, Problem Reduction, Constraint Satisfaction, Means-ends Analysis	

UNIT – 3	7 Hrs
Knowledge Representation: Propositional Logic – Syntax and Semantics, Using Propositional Logic, First-Order Logic – Syntax and Semantics, Using First-Order Logic **Representing Knowledge using Rules:** Procedural Versus Declarative Knowledge, Forward Versus Backward Reasoning.	

UNIT – 4	7 Hrs
Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability notation, The Axioms of Probability, Bayes' Rule and its Use, Where do Probabilities come from?, Representing Knowledge in an Uncertain Domain, The Semantics of Belief Networks.	

UNIT - 5	7 Hrs
Introduction to Expert Systems: Definition, Features of an Expert System, Organization, Characteristics, Prospector, Knowledge Representation in Expert Systems, Expert System tools – MYCIN, EMYCIN.	

Text Books:

1.Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.

Reference Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015.
2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.

e-Books :

1. http://www.e-booksdirectory.com/details.php?ebook=9845
2. http://www.e-booksdirectory.com/details.php?ebook=5643

MOOCS

1. https://www.edx.org/course/artificial-intelligence-uc-berkeleyx-cs188-1x
2. https://www.udacity.com/course/intro-to-artificial-intelligence--cs271
3. https://www.class-central.com/subject/ai

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the concept of agents, environments, search strategies, reasoning, logic and probabilities.
CO2	Solve problems using uninformed and informed search strategies.
CO3	Represent procedural and declarative knowledge by applying agent-based rules.
CO4	Provide logic-based analysis for question and answering techniques.
CO5	Formulate probabilities for handling uncertain knowledge.

Course Title	COMPUTER GRAPHICS				
Course Code	20IS5PECGS	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	6 Hrs
Video display devices, Raster-Scan systems, Graphics Workstations and Viewing Systems, Input devices, Coordinate representations, Graphics functions, Software standards, Introduction to Open GL, Coordinate reference frames, specifying a two-dimensional world coordinate reference frame.	

UNIT – 2	7 Hrs
Open GL point, line and curve functions, Fill-area primitives, Polygon fill areas, OpenGL polygon fill area functions, Line drawing algorithms, Circle generating algorithms, Ellipse-generating algorithms, Other Curves, Pixel addressing and Object Geometry.	

UNIT – 3	8 Hrs
Basic two-dimensional geometric transformations, Matrix representations and Homogeneous coordinates, Inverse transformations, Reflection and Shear, Transformation between 2D coordinate systems, OpenGL functions for 2D geometric transformations, Three-dimensional Translation, Rotation and Scaling, 3D reflection and shear, Transformation between 3D coordinate systems, Affine transformations, OpenGL geometric transformation functions.	

UNIT – 4	8 Hrs
Two-dimensional viewing pipeline, Clipping window, Normalization and view port transformations, Clipping algorithms, Two-dimensional point and line clipping, Polygon fill-area clipping; Overview of three-dimensional viewing concepts, Three-dimensional viewing pipeline, Three-dimensional viewing coordinate parameters, Transformation from world to viewing coordinates, Projection transformations, Orthogonal projections, Perspective projections, Viewport transformation and three dimensional screen coordinates.	

UNIT - 5	7 Hrs
Cubic-spline interpolation methods, Bezier spline curves, B-Spline curves, Raster methods for computer animation, Design of animation sequences, traditional animation techniques, Computer animation Languages, Key frame Systems, Motion specifications, Character animation, Periodic Motions, OpenGL Animation Procedures.	

Text Book: 1. Computer Graphics with OpenGL, Donald D. Hearn, M. Pauline Baker and Warren Carither, 4th edition, Pearson Education, 2019.

Reference Books:

1. John F Hughes, Andries van Dam, Steven K. Feiner, James D. Foley, Morgan McGuire, David F Sklar and Kurt Akeley, Computer Graphics: Principles and Practice, 3rd edition, Pearson Education, 2018.
2. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition, Pearson Education, 2013.

e-Books :

1. Introduction to Computer Graphics, David J Eck, http://math.hws.edu/eck/cs424/downloads/graphicsbook-linked.pdf
2. Fundamentals of Computer Graphics, Dr. John Collomosse http://personal.ee.surrey.ac.uk/Personal/J.Collomosse/pubs/cm20219.pdf

MOOCS

1. Interactive Computer Graphics, https://www.classcentral.com/course/interactivegraphics-2067
2. Computer Graphics, https://www.edx.org/course/computer-graphics
3. Interactive 3D Graphics, https://www.udacity.com/course/interactive-3d-graphics--cs291

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend on graphics coordinate representation, algorithms, geometric transformations, viewing pipeline, clipping, projections, spline curves and animation.
CO2	Apply the knowledge of graphics primitives, algorithms, transformations and animation procedures to depict OpenGL functions.
CO3	Analyze transformation between coordinate systems, world to viewing coordinates, viewport-screen coordinates, projections and key frames to formulate mathematical symbolizations.
CO4	Investigate matrix depictions and coordinate reference formats to deduce two-dimensional and three-dimensional geometric representations.
CO5	Conceptualize on coordinate systems and 3D projections.
CO6	Ascertain strategies for clipping algorithms, interpolation methods and motion specifications.

Course Title	CRYPTOGRAPHY AND NETWORK SECURITY				
Course Code	20IS6PCCNS	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	8 Hrs

Introduction

Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security

Classical Encryption Techniques

Symmetric Cipher Model, Substitution Techniques – Caesar Cipher, Monoalphabetic Ciphers, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One-Time Pad, Transposition Techniques

UNIT – 2	7 Hrs

Block Ciphers

Traditional Block Cipher Structure – Stream Ciphers and Block Ciphers, Motivation for the Feistel Cipher Structure, The Feistel Cipher, Block Cipher Design Principles, The Simplified Data Encryption Standard (S-DES) – S-DES Encryption, S-DES Decryption, S-DES Key Generation.

Stream Ciphers

Stream Ciphers, RC4 – Initialization of S, Stream Generation, Strength of RC4

UNIT – 3	7 Hrs

Public-Key Cryptosystems

Principles of Public-Key Cryptosystems – Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptosystems, Public-Key Cryptanalysis, The RSA Algorithm – Description of the Algorithm, Computational Aspects, The Security of RSA, Diffie-Hellman Key Exchange – The Algorithm, Key Exchange Protocols, Man-in-the-Middle Attack.

Cryptographic Hash Functions

Secure Hash Algorithm (SHA) – SHA-512 Logic, SHA-512 Round Function, Example

UNIT – 4	7 Hrs

Key Management and Distribution

Symmetric Key Distribution using Symmetric Encryption, Symmetric Key Distribution using Asymmetric Encryption, Distribution of Public Keys.

Transport-Level Security

Transport Layer Security – Architecture, Record Protocol, Change Cipher Spec Protocol,

Alert Protocol, Handshake Protocol, Cryptographic Computations, Heartbeat Protocol, SSL/TLS Attacks, HTTPS – Connection Initiation, Connection Closure.

UNIT - 5	7 Hrs

Digital Signatures

Digital Signatures – Properties, Attacks and Forgeries, Digital Signature Requirements, Direct Digital Signature, SCHNORR Digital Signature Scheme, NIST Digital Signature Algorithm

IP Security

IP Security Overview – Applications, Benefits, Routing Applications, IPSec Documents, IPSec Services, IP Security Policy – Security Associations and its Database, Security Policy Database, IP Traffic Processing, Encapsulating Security Payload – ESP Format, Encryption and Authentication Algorithms, Padding, Anti-Replay Service, Transport and Tunnel Modes, Internet Key Exchange – Key determination Protocol, Header and Payload Formats.

Text Books :

1. Cryptography and Network Security – Principles and Practice by William Stallings, Person, 7th Edition, 2017.

Reference Books :

1. Network Security Essentials Applications and Standards, William Stallings, Pearson, 4th Edition, 2012.
2. Network Security Private Communication in a Public world, Charlie Kaufman, Radia Perlman and Mike Speciner, 2nd Edition, PHI, 2013.
3. Network Security and Management, Brijendra Singh, 3rd Edition, PHI, 2013.

e-Books :

1. https://dl.hiva-network.com/Library/security/Cryptography-and-network-security-principles-and-practice.pdf
2. https://imcs.dvfu.ru/lib.int/docs/Networks/Security/Network%20Security%20Foundations.pdf

MOOCS

1. https://www.mooc-list.com/course/network-security-wma
2. https://www.coursera.org/learn/crypto
3. https://www.coursera.org/specializations/applied-crypto

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the basic concepts of classical encryption techniques, block ciphers, stream ciphers, cryptographic functions, key management and IP security.
CO2	Apply the knowledge of classical encryption techniques to solve cryptographic problems.
CO3	Analyze the structure of various block ciphers and stream ciphers.
CO4	Evaluate public key cryptosystems, hash functions and key distribution techniques.
CO5	Analyze transport level security, IP security and digital signatures.

Course Title	**COMPUTER NETWORKS - 2**				
Course Code	**20IS6PCCON**	**Credits**	**4**	**L-T-P**	**3-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**5**	**Total Lecture Hours**			**36**

UNIT – 1	7 Hrs

The Transport Layer: Services provided to the upper layers, Transport service primitives, Elements of transport protocols: Addressing, Connection establishment, Connection release, Error control and flow control, Introduction to UDP, Remote procedure call, The Internet Transport Protocols: TCP - protocol, segment header, Connection establishment, connection release, Sliding window, Congestion control.

UNIT – 2	8 Hrs

Application layer –I

Socket Programming: Client-Server Model Of Interaction, The Client-Server Model, A Trivial Example: UDP Echo Server , Time And Date Service ,Sequential And Concurrent Servers ,Server Complexity, Broadcasting Requests ,Client-Server Alternatives And Extensions.

The Socket API: Introduction, Versions Of The Socket API , The UNIX I/O Paradigm And Network I/O ,Adding Network I/O to UNIX ,The Socket Abstraction And Socket Operations, Obtaining And Setting Socket Options ,How A Server Accepts TCP Connections ,Servers That Handle Multiple Services , Obtaining And Setting The Host Name , Library Functions Related To Sockets , An Example Client ,An Example Server.

UNIT – 3	7 Hrs

Application layer-II.

The Domain Name System (DNS), Introduction, Names For Computers, Flat Namespace , Hierarchical Names , Delegation Of Authority For Names ,Subset Authority , Internet Domain Names, Top-Level Domains Name Syntax And Type, Mapping Domain Names To Addresses, Domain Name Resolution, Efficient Translation ,Caching: The Key To Efficiency , Domain Name System Message Format, Compressed Name Format , Abbreviation Of Domain Names ,Inverse Mappings, Pointer Queries, Object Types And Resource Record Contents, Obtaining Authority For A Subdomain ,Server Operation And Replication ,Dynamic DNS Update And Notification , DNS Security Extensions (DNSSEC) , Multicast DNS And Service Discovery.

Electronic Mail (SMTP, POP, IMAP, MIME), Electronic Mail, Mailbox Names And Aliases, Alias Expansion And Mail Forwarding, TCP/IP Standards For Electronic Mail Service, Simple Mail Transfer Protocol (SMTP) , Mail Retrieval And Mailbox Manipulation Protocols, The MIME Extensions For Non-ASCII Data , MIME Multipart Messages.

UNIT – 4	7 Hrs

Voice And Video Over IP (RTP, RSVP, QoS), Introduction, Digitizing And Encoding, Audio And Video Transmission And Reproduction, Jitter And Playback Delay, Real-time Transport Protocol (RTP) ,Streams, Mixing, And Multicasting, RTP Encapsulation , RTP Control Protocol (RTCP), RTCP Operation, IP Telephony And Signaling, Quality Of Service Controversy, QoS, Utilization, And Capacity, Emergency Services And Preemption ,IntServ And Resource Reservation, DiffServ And Per-Hop Behavior, Traffic Scheduling, Traffic Policing And Shaping.

UNIT - 5	7 Hrs

Network Management (SNMP): Introduction, The Level Of Management Protocols, Architectural Model, Protocol Framework, Examples of MIB Variables, The Structure Of Management Information, Formal Definitions Using ASN.1, Structure And Representation Of MIB Object Names, MIB Changes And Additions For IPv6, Simple Network Management Protocol, SNMP Message Format, An Example Encoded SNMP Message.

Text Books:

1. Computer Networks, Andrew S Tannenbaum and David J wetherall, Pearson, 5th Edition,2014
2. Internetworking with TCP/IP: Principles, Protocols, and Architecture Douglas E. Commer Prentice Hall Edition 6th Edition, 2014.

Reference Books:

1. Ying-Dar Liu, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill, 2011.
2. W. Richard Stevens, Bill Fenner and Andrew Rudoff, "Unix Network Programming", Volumes 1 and 2, Third Edition, Addison-Wesley Professional, 2003.
3. Michael Donahoo, Ken Calvert, Pocket Guide to TCP/IP Socket Programming in C, Morgan Kaufmann Series in Networking, 2000.
4. Behrouz A. Forouzan, Data Communication and Networking, McGraw-Hill.

e-Books :

1. https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2012/02/Computer-Networking-Principles-Bonaventure-1-30-31-OTC1.pdf
2. https://cseweb.ucsd.edu/~gmporter/classes/wi19/cse124/courseoverview/compnetworks.pdf

MOOCS:

1. http://www.nptelvideos.in/2012/11/computer-networks.html
2. https://www.coursera.org/learn/tcpip

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the working principle of Transport and Application layers along with related protocols and Concepts of Network management protocols.
CO2	Apply the knowledge of various Client-Server Models, protocol Software, network communication approaches in building client-server applications and TCP/IP socket programs.
CO3	Analyse the functionalities of various Application layer Protocol like HTTP (HyperText Transfer Protocol), Domain Name System (DNS), Electronic Mail (SMTP, POP, IMAP, MIME Voice And Video Over IP and Simple Network Management Protocol.
CO4	Design solutions for real time applications by executing client server programs using advanced library for different services of Application Layer Protocols.
CO5	Conduct Experiments on various protocols of Application and Transport Layer.

Course Title	SOFTWARE TESTING				
Course Code	20IS6PCSTG	Credits	4	L-T-P	3-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	5	Total Lecture Hours			36

UNIT – 1	8 Hrs

BASIC CONCEPTS AND PRELIMINARIES - Software Quality, Role of Testing, Verification and Validation, Failure, Error, Fault, and Defect, Notion of Software Reliability, Objectives of Testing, What Is a Test Case?, Expected Outcome, Concept of Complete Testing, Central Issue in Testing , Testing Activities, Test Levels, Sources of Information for Test Case Selection, White-Box, Black-Box and Gray-Box Testing, Test Planning and Design, Monitoring and Measuring Test Execution, Test Tools and Automation, Test Team Organization and Management.

A Perspective on Testing - Basic Definitions, Test Cases, Insights from a Venn Diagram, Identifying Test Cases, Specification-Based Testing, Code-Based Testing, Specification-Based versus Code-Based Debate, Fault Taxonomies, Levels of Testing.

UNIT – 2	9 Hrs

Unit Testing: Concept of Unit Testing, Static Unit Testing, Defect Prevention, Dynamic Unit Testing, Mutation Testing, Debugging, Unit Testing in eXtreme Programming, JUnit: Framework for Unit Testing.

Boundary Value Testing- Normal Boundary Value Testing, Robust Boundary Value Testing, Worst-Case Boundary Value Testing, Test Cases for the Triangle Problem, Random Testing.

Equivalence Class Testing- Equivalence Classes, Traditional Equivalence Class Testing, Improved Equivalence Class Testing, Equivalence Class Test Cases for the Triangle Problem.

UNIT – 3	7 Hrs

Data Flow Testing- General Idea, Data Flow Anomaly, Overview of Dynamic Data Flow Testing, Data Flow Graph, Data Flow Terms, Data Flow Testing Criteria, Comparison of Data Flow Test Selection Criteria

Object-Oriented Testing -   Object-Oriented Unit Testing, Object-Oriented Integration Testing, Object-Oriented System Testing.

UNIT – 4	6 Hrs

SYSTEM INTEGRATION TESTING -Concept of Integration Testing, Different Types of

Interfaces and Interface Errors, Granularity of System Integration Testing, System Integration Techniques, Test Plan for System Integration. **FUNCTIONAL TESTING -** Equivalence Class Partitioning, Boundary Value Analysis	
UNIT - 5	**6 Hrs**
What Is User Acceptance Testing? When Is It Performed? Who Performs UAT? Need For User Acceptance Testing, User Acceptance Testing Process, UAT Test Planning,User Acceptance Testing Design,Test Execution. **SOFTWARE QUALITY**- Five Views of Software Quality, McCall's Quality Factors and Criteria, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard	

Text Books :

1. "SOFTWARE TESTING AND QUALITY ASSURANCE Theory and Practice – 2nd Edition" by KSHIRASAGAR NAIK and PRIYADARSHI TRIPATHY, 2008.

2. "Software Testing, A Craftsman's Approach, C Paul C. Jorgensen, Auerbach Publications, 4th Edition, 2014"

3. https://www.softwaretestinghelp.com/what-is-user-acceptance-testing-uat/

Reference Books :

1. Foundations of Software Testing, Aditya P Mathur, Pearson, 2008.

2. Software Testing and Analysis – Process, Principles and Techniques, Mauro Pezze, Michal Young, John Wiley & Sons, 2008

e-Books :

1. http://index-of.co.uk/Software-Testing/STQA_book.pdf

MOOCS:

1. https://nptel.ac.in/courses/106/105/106105150/
2. https://nptel.ac.in/courses/106/101/106101163/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the importance of software testing fundamentals, methodologies and tools.
CO2	Apply the knowledge of software testing strategies and methodologies for various types of testing.
CO3	Analyze the given problem using various types of testing such as Unit Testing, Boundary value testing, Equivalence testing, data flow testing, object oriented testing, System integration testing , Functional testing and user acceptance testing.
CO4	Design effective test cases to achieve requirement specification.
CO5	Investigate various testing strategies to find bugs in the software.
CO6	Demonstrate the usage of modern testing tools to write automation scripts.

Course Title	SOFTWARE PROJECT MANAGEMENT AND FINANCE				
Course Code	20IS6HSPMF	Credits	2	L-T-P	2-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	2	Total Lecture Hours			24

UNIT – 1	4 Hrs
Introduction, Purpose of the *PMBOK,* What is a Project?, The Relationships Among Portfolios, Programs, and Projects, What is Project, Management?, R elationships Among Portfolio Management, Program Management, Project, Management, and Organizational Project ,Management, Program Management, Portfolio Management ,Projects and Strategic Planning, Project Management Office. **ORGANIZATIONAL INFLUENCES AND PROJECT LIFE CYCLE** Organizational Influences on Project Management, Organizational Cultures and Styles,Organizational Communications., Organizational Structures, Organizational Process Assets, Enterprise Environmental Factors,Project Stakeholders and Governance, Project Stakeholders,Project Governance, Project Success, Project Team,Composition of Project Teams,Project Life Cycle, Characteristics of the Project Life Cycle, **Project Phases** **PROJECT MANAGEMENT PROCESSES** Common Project Management Process Interactions, Project Management Process Groups, Initiating Process Group,Planning Process Group., Executing Process Group, Monitoring and Controlling Process Group,Closing Process Group, Project Information, Role of the Knowledge Areas	

UNIT – 2	5 Hrs
PROJECT INTEGRATION MANAGEMENT-Develop Project Charter, Develop Project Charter: Inputs, Develop Project Charter: Tools and Techniques, Develop Project Charter: Outputs, Develop Project Management Plan, Develop Project Management Plan: Inputs, Develop Project Management Plan: Tools and Techniques, Develop Project Management Plan: Outputs **Direct and Manage Project Work-**Direct and Manage Project Work: Inputs, Direct and Manage Project Work: Tools and Techniques, Direct and Manage Project Work: Outputs, Monitor and Control Project Work, Monitor and Control Project Work: Inputs, Monitor and Control Project Work: Tools and Techniques., Monitor and Control Project Work: Outputs, Perform Integrated Change Control, Perform Integrated Change Control: Inputs, Perform Integrated Change Control: Tools and Techniques, Perform Integrated Change Control: Outputs. **Close Project or Phase-**Close Project or Phase: Inputs, Close Project or Phase: Tools and Techniques, Close Project or Phase: Outputs **PROJECT SCOPE MANAGEMENT-**Plan Scope Management., Plan Scope Management: Inputs, Plan Scope Management: Tools and Techniques, Plan Scope Management: Outputs, Collect Requirements, Collect Requirements: Inputs, Collect Requirements: Tools and Techniques, Collect Requirements: Outputs, Define Scope, Define Scope: Inputs, Define	

Scope: Tools and Techniques, Define Scope: Outputs,

Create WBS-Create WBS: Inputs, Create WBS: Tools and Techniques, Create WBS: Outputs, Validate Scope, Validate Scope: Inputs, Validate Scope: Tools and Techniques, Validate Scope: Outputs, Control Scope, Control Scope: Inputs, Control Scope: Tools and Techniques, Control Scope: Outputs

PROJECT TIME MANAGEMENT- Plan Schedule Management, Plan Schedule Management: Inputs,Plan Schedule Management: Tools and Techniques, Plan Schedule Management: Outputs, Define Activities, Define Activities: Inputs, Define Activities: Tools and Techniques, Define Activities: Outputs, Sequence Activities, Sequence Activities: Inputs, Sequence Activities: Tools and Techniques, Sequence Activities: Outputs, Estimate Activity Resources, Estimate Activity Resources: Inputs, Estimate Activity Resources: Tools and Techniques, Estimate Activity Resources: Outputs

UNIT – 3	5 Hrs

PROJECT HUMAN RESOURCE MANAGEMENT- Plan Human Resource Management, Plan Human Resource Management: Inputs, Plan Human Resource Management: Tools and Techniques, Plan Human Resource Management: Outputs, Acquire Project Team, Acquire Project Team: Inputs, Acquire Project Team: Tools and Techniques, Acquire Project Team: Outputs, Develop Project Team, Develop Project Team: Inputs, Develop Project Team: Tools and Techniques, Develop Project Team: Outputs

Manage Project Team- Manage Project Team: Inputs, Manage Project Team: Tools and Techniques, Manage Project Team: Outputs

PROJECT RISK MANAGEMENT- Plan Risk Management, Plan Risk Management: Inputs, Plan Risk Management: Tools and Techniques, Plan Risk Management: Outputs, Identify Risks, Identify Risks: Inputs, Identify Risks: Tools and Techniques, Identify Risks: Outputs, Perform Qualitative Risk Analysis, Perform Qualitative Risk Analysis: Inputs, Perform Qualitative Risk Analysis: Tools and Techniques, Perform Qualitative Risk Analysis: Outputs, Perform Quantitative Risk Analysis, Perform Quantitative Risk Analysis: Inputs, Perform Quantitative Risk Analysis: Tools and Techniques, Perform Quantitative Risk Analysis: Output.

Plan Risk Responses- Plan Risk Responses: Inputs, Plan Risk, Responses: Tools and Techniques, Plan Risk Responses: Outputs, Control Risks, Control Risks: Inputs, Control Risks: Tools and Techniques, Control Risks: Outputs

PROJECT STAKEHOLDER MANAGEMENT- Identify Stakeholders, Identify Stakeholders: Inputs, Identify Stakeholders: Tools and Techniques, Identify Stakeholders: Outputs.

Plan Stakeholder Management- Plan Stakeholder Management: Inputs, Plan Stakeholder Management: Tools and Techniques, Plan Stakeholder Management: Outputs, Manage Stakeholder Engagement, Manage Stakeholder Engagement: Inputs, Manage Stakeholder Engagement: Tools and Techniques, Manage Stakeholder Engagement: Outputs, Control Stakeholder Engagement, Control Stakeholder Engagement: Inputs, Control Stakeholder Engagement: Tools and Techniques, Control Stakeholder Engagement: Outputs.

UNIT – 4	5 Hrs

PROJECT COST MANAGEMENT- Plan Cost Management, Plan Cost Management: Inputs, Plan Cost Management: Tools and Techniques, Plan Cost Management: Outputs,

Estimate Costs, Estimate Costs: Inputs, Estimate Costs: Tools and Techniques, Estimate Costs: Outputs, Determine Budget, Determine Budget: Inputs, Determine Budget: Tools and Techniques, Determine Budget: Outputs, Control Costs, Control Costs: Inputs, Control Costs: Tools and Techniques, Control Costs: Outputs

PROJECT QUALITY MANAGEMENT- Plan Quality Management, Plan Quality Management: Inputs, Plan Quality Management: Tools and Techniques, Plan Quality Management: Outputs

Perform Quality Assurance, Perform Quality Assurance: Inputs, Perform Quality Assurance: Tools and Techniques., Perform Quality Assurance: Outputs, Control Quality, Control Quality: Inputs, Control Quality: Tools and Techniques, Control Quality: Outputs

UNIT - 5	5 Hrs

Entrepreneurship- Vision – Start, Define, Learn, Experiment, Steer – Leap, Test, Measure, Accelerate – Adapt, Innovate Accelerate – Batch, Grow Pivot, Case Studies**.**

Text Book:

1. A Guide to the Project Management Body of Knowledge (PMBOK Guide)-5th edition

Reference Book:

1. Project Management by Vasant Desai, Himalaya Publishing House

e-Books :

1. http://www.opentextbooks.org.hk/system/files/export/15/15694/pdf/Project_Management_15694.pdf

MOOCS:

1. https://blog.capterra.com/the-5-best-online-project-management-courses/#5
2. https://blog.capterra.com/the-5-best-online-project-management-courses/#3

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Gain an overview on project management framework, knowledge areas, financial management and managing startups.
CO2	Examine the knowledge areas of software project management.
CO3	Prepare a cost estimate and budget for case studies of software projects.
CO4	Envisage the model of entrepreneurship management in varied environments.

Course Title	**SOFTWARE ARCHITECTURE AND DESIGN PATTERNS**					
Course Code	**20IS6PESAO**	**Credits**	**3**	**L-T-P**	**2-1-0**	
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**			
Contact Hours / Week	**4**	**Total Lecture Hours**			**24**	

UNIT – 1	**4 Hrs**

Patterns: What is a Pattern?, What Makes a Pattern?, Pattern Categories, Relationships between Patterns, Pattern Description, Patterns and Software Architecture.

UNIT – 2	**6 Hrs**

Architectural Patterns: Introduction, From Mud to Structure, Layers, Pipes and Filters,. Distributed Systems, Broker-Structure and dynamics basics, Interactive Systems, Model-View-Controller. Presentation-Abstraction-Control.

UNIT – 3	**5 Hrs**

Design Patterns: Introduction, Structural Decomposition, Whole-Part, Access Control, Proxy, Management, Command Processor, View Handler, Communication, Forwarder-Receiver, Client-Dispatcher-Server, Publisher-Subscriber.

UNIT – 4	**5 Hrs**

Idioms: Introduction, What Can Idioms Provide?, Idioms and Style, Where Can You Find Idioms?, Counted Pointer.- Case study.

Pattern Systems: What is a Pattern System? , Pattern Classification, Pattern Selection, Pattern Systems as Implementation Guidelines.

UNIT - 5	**4 Hrs**

Patterns and Software Architecture: Introduction, Patterns in Software Architecture, Enabling Techniques for Software Architecture, Non-functional Properties of Software Architecture.

The Pattern Community: The Roots, Leading Figures and their Work, The Community.

Text Book :

1. Pattern-Oriented Software Architecture A System of Patterns, by Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad and Michael Stal, Volume 1, Wiley series in Software Design Patterns.

Reference Books :

1. Software Architecture Patterns by Mark Richards , O'Reilly , February 2015.
2. Software Architecture in Practice (3rd edition), by Len Bass, Paul Clements, and Rick Kazman, Addison-Wesley, 2012.
3. Design Patterns: Elements of Reusable Object-Oriented Software, by Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Addison-Wesley, 1995. (online book, use Internet Explorer to view).

e-Books :

1. https://ff.tu-sofia.bg/~bogi/knigi/SE/Wiley%20-%20Pattern-Oriented%20Software%20Architecture%20-%20Volume%201,%20A%20System%20of%20Patterns.pdf

MOOCS:

1. https://www.coursera.org/specializations/software-design-architecture
2. https://www.classcentral.com/course/udacity-software-architecture-design-3418
3. https://www.udacity.com/course/software-architecture-design--ud821

Resources:

1. https://sourcemaking.com/design_patterns
2. http://www.cs.unb.ca/~wdu/cs4015/
3. https://techbus.safaribooksonline.com/video/programming/java/9780133489989?bookview=overview

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend patterns for software architecture, system architecture Skelton, design pattern, catalog, pattern systems and community.
CO2	Interpret architectural patterns, designs patterns, Idioms, software architecture, organizing patterns into pattern systems.
CO3	Identify design patterns, architectural patterns and software architectural style.
CO4	Analyze software architecture, designs patterns and architectural patterns.
CO5	Demonstrate architectural patterns, design pattern concepts, pattern systems and software architecture.

Course Title	**SOCIAL NETWORK ANALYSIS**				
Course Code	**20IS6PESNA**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lecture Hours**			**24**

UNIT – 1	**4 Hrs**
Graphs and Matrices : Why Graphs? Graphs, Digraphs, Bipartites, Multigraphs, Hypergraphs.	
UNIT – 2	**5 Hrs**
Strong and Weak Ties: Triadic Closure, The Strength of Weak Ties, Tie Strength and Network Structure in Large-Scale Data, Tie Strength, Social Media, and Passive Engagement, Closure, Structural Holes, and Social Capital. **Networks In Their Surrounding Contexts**: Homophily, Mechanisms Underlying Homophily: Selection and Social Influence, Affiliation.	
UNIT – 3	**5 Hrs**
Positive and Negative Relationships : Structural Balance, Characterizing the Structure of Balanced Networks. **Structure of the Web** : The World Wide Web, Information Networks, Hypertext, and Associative Memory, The Web as a Directed Graph.	
UNIT – 4	**5 Hrs**
Link Analysis and Web Search: Searching the Web: The Problem of Ranking, Link Analysis using Hubs and Authorities, PageRank . **Cascading Behavior in Networks**: Diffusion in Networks, Modeling Diffusion through a Network, Cascades and Clusters, Diffusion, Thresholds, and the Role of Weak Ties.	
UNIT - 5	**5 Hrs**
The Small-World Phenomenon: Six Degrees of Separation, Structure and Randomness, Decentralized Search, Modeling the Process of Decentralized Search, Core-Periphery Structures and Difficulties in Decentralized Search.	

Text Books :

1. Social Network Analysis: Methods and Applications, Stanley Wasserman, Katherine Faust, Cambridge University Press, 2012 (Unit 1)
2. Networks, Crowds, and Markets : Reasoning about a Highly Connected World : David Easley, Jon Kleinberg

Reference Book :

1. Social Network Analysis by John Scott, 3rd edition, SAGE publications Ltd, 2012.

2. Understanding-Social-Networks-Theories-Concepts-and findings by Charles Kadushin,   Oxford university press, 2012.
3. Social and Economic Networks – Matthew O Jackson

e-Books :

1. Social Network Analysis theory and applications
   https://www.archiv.politaktiv.org/documents/10157/29141/SocNet_TheoryApp.pdf
2. Introduction to Social Network methods
   http://www.analytictech.com/networks.pdf

MOOCS

1. https://www.coursera.org/learn/python-social-network-analysis#syllabus
2. https://www.coursera.org/learn/social-economic-networks#syllabus
3. https://nptel.ac.in/content/syllabus_pdf/106106169.pdf

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the basic knowledge of social network analysis to comprehend the definitions and properties of graphs with suitable notations
CO2	Apply the properties of graphs to interpret the network balancing, information cascade, explore the evolution of networks and link prediction problem
CO3	Analyse the links of graphs and behaviour of node characteristics, measures of distance in path analysis
CO4	Interpret centrality of a node in a network using various measures and explore spread of information
CO5	Use modern tools to demonstrate network, visualizations and perform empirical investigations of social network data

Course Title	**BIG DATA ANALYTICS**				
Course Code	**20IS6PEBDA**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lecture Hours**			**24**

UNIT – 1	**5 Hrs**
Introduction to Big Data: Types of Digital Data- Classification of Digital Data Structured Data, Semi-Structured Data and Unstructured Data, Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, what is Big Data? Why Big Data? Traditional Business Intelligence Versus Big Data, Big Data framework **Big Data Analytics** – What is Big Data Analytics? Classification of Analytics, Top Challenges Facing Big Data. Introduction to Hadoop – Introducing Hadoop, Why Hadoop?, Why not RDBMS?, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop, Hadoop Overview, Installation of Hadoop Use Case of Hadoop.	
UNIT – 2	**5 Hrs**
Hadoop Distributed File System: Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator), **Introduction to MAPREDUCE Programming:** Introduction, Mapper, reducer, Combiner, Partitioner, Searching, Sorting, Compression.	
UNIT – 3	**4 Hrs**
Cassandra – Apache Cassandra - An Introduction, Features of Cassandra, CQL Data types, CQLSH, Keyspaces, CRUD (Create, Read, Update and Delete) Operations, Collections, Using a Counter, Time to Live (TTL), Alter Commands, Import and Export, Querying System Tables, Practice Examples **Hive** – What is Hive?, Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), RCFile Implementation, SerDe, User-defined Function(UDF).	
UNIT – 4	**5 Hrs**
Spark – Installing Spark, An Example, Spark Applications, Jobs, Stages, and Tasks, A Scala Standalone Application, A Java Example, A Python Example, Resilient Distributed Datasets Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers, Spark on YARN.Big Data integration,analytics and visualization using Lumify, DataWrapper. **Sqoop:** Introduction, Installation, Import and Export.	

UNIT - 5	5 Hrs

Data Ingestion Tools:

Apache Zookeeper: What is Apache Zookeeper?Introduction to Apache Zookeeper,Why do we need Zookeeper in Hadoop?How ZooKeeper in Hadoop Works?Writes in Zookeeper,Reads in Zookeeper,How to Use Apache ZooKeeper to Build Distributed Apps?Installing Apache ZooKeeper.

Apache Flume - Introduction, Architecture, DataFlow, Features and Limitations, Applications.

Text Books :

1. Seema Acharya,Subhashini Chellappan, Big data and Analytics, Wiley publications, 2014.
2. Big Data Analytics with R and Hadoop, Vignesh Prajapati, -Packt Publishing 2013.
3. https://mapr.com/ebook/getting-started-with-apache-spark-v2/assets/Spark2018eBook.pdf
4. https://riptutorial.com/Download/sqoop.pdf
5. http://3.droppdf.com/files/qgktT/apache-sqoop-cookbook.pdf

Reference Books :

1. Tom White, Hadoop: The Definitive Guide, Fourth Edition, O'Reilly, 2015
2. Hrushikesha Mohanty, Prachet Bhuyan, Deepak Chenthati Editors Big Data A Premier Springer Volume 11
3. Using Flume: Flexible, Scalable, and Reliable Data Streaming by Hari Shreedharan

e-Books :

1. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game",1st Edition, IBM Corporation, 2012

MOOCS

1. https://www.coursera.org/courses?query=introduction%20to%20big%20data%20analytics
2. https://www.edx.org/learn/big-data
3. https://swayam.gov.in/nd1_noc20_cs46/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the concepts of Hadoop, HDFS, Map Reduce, YARN, Hadoop I/O, Cassandra, Hive, Sqoop, Spark, Apache ZooKeeper, Apache Flume and operations for analytics of big data.
CO2	Apply the knowledge of Hadoop distributed file system, Cassandra, Hive, Sqoop, Spark, Apache ZooKeeper, Apache Flume for solving real time problems
CO3	Identify the appropriate concepts of big data to solve a given use-case.
CO4	Design solutions for applications using appropriate big data concepts.
CO5	Conduct experiments using modern big data tools like Cassandra, Hive, Sqoop, Spark, Apache ZooKeeper, Apache Flume to solve given problems.
CO6	Communicate effectively in a team and investigate on the topics related to big data.

Course Title	**PATTERN RECOGNITION**				
Course Code	**20IS6PEPRN**	**Credits**	**3**	**L-T-P**	**2-1-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lecture Hours**			**24**

UNIT – 1	5 Hrs

Machine perception, an example; Pattern recognition systems, Design cycle, Bayesian decision theory-Continuous features, Minimum error rate classification, classifiers, discriminant functions, and decision surfaces, Normal density, Discriminant functions for Normal density.

UNIT – 2	5 Hrs

Maximum-likelihood estimation, Bayesian estimation, Bayesian parameter estimation: Gaussian case. Non-parametric techniques: Density estimation, Parzen windows, k_n -Nearest-Neighbor Estimation, Nearest-neighbor rule.

UNIT – 3	4 Hrs

Linear discriminant functions and decision surfaces, generalized linear discriminant functions, Two-category linearly separable case, Minimizing the perceptron criterion functions, Relaxation Procedures, Minimum squared-error and pseudoinverse, LMS procedure.

UNIT – 4	5 Hrs

Stochastic search, Boltzmann learning: Stochastic Boltzmann learning of visible states, missing features and category constraints, Evolutionary methods: Genetic algorithms. Non-parametric methods: Decision Trees, CART.

UNIT - 5	5 Hrs

Mixture densities and identifiability, Maximum likelihood estimates, Application to Normal mixtures, Unsupervised Bayesian learning, Data description and clustering, Criterion functions for clustering.

Text Book :

1. Pattern Classification by Richard O. Duda, Peter E. Hart, and David G. Stork, 2nd Edition, John Wiley, Student edition, 2014.

Reference Books :

1. Pattern Recognition and Machine Learning, Christopher M. Bishop, 3rd Edition, Springer, 2007.
2. Statistical Pattern Recognition, Andrew R. Webb, 2nd Edition, John Wiley, 2002.

e-Books :

1. Pattern Recognition: Introduction and Technology, Robert P.W. Duin and Elzbieta Pekalska, http://www.37steps.com/data/pdf/PRIntro_medium.pdf

2. Hands-On Pattern Recognition,
   http://www.mtome.com/Publications/CiML/CiML-v1-book.pdf

MOOCS

1. Pattern Recognition and Application, https://www.classcentral.com/course/swayam-pattern-recognition-and-application-14228
2. Intro to Clustering, https://www.coursera.org/lecture/machine-learning-with-python/intro-to-clustering-Nlxjw

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend on the basics of pattern recognition systems, discriminant functions, non-parametric techniques, stochastic search and clustering.
CO2	Apply pattern classification techniques to arrive at valid solutions in supervised and unsupervised learning paradigms.
CO3	Evaluate the categorization and decision functions to minimize errors.
CO4	Estimate mathematical notions using parameters, densities, features, criterion functions and convergence proofs.
CO5	Identify algorithms and models to provide impactful recommendations from classification data.

Course Title	**MOBILE COMPUTING AND 5G TECHNOLOGIES**				
Course Code	**20IS6PEMCT**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lecture Hours**			**24**

UNIT – 1	**5 Hrs**
Introduction: PCS Architecture, Cellular Telephony, Mobility Management: Handoff, Roaming Management, Handoff Management: Detection and Assignment -Handoff Detection, Strategies for Handoff Detection, Channel Assignment. GSM System for mobile communications: GSM System for mobile communications, GSM Architecture.	
UNIT – 2	**5 Hrs**
Rationale of 5G: high data volume, twenty-five billion connected devices and wide requirements : Security, Standardization activities: ITU-R 15, 3GPP, IEEE; 5G use cases and system concept : Use cases and requirements , Use cases , Requirements and key performance indicators; 5G system concept : Concept overview, Extreme mobile broadband, Massive machine-type communication, Ultra-reliable machine-type communication , Dynamic radio access network, Lean system control plane, Localized contents and traffic flows , Spectrum toolbox.	
UNIT – 3	**5 Hrs**
The 5G architecture Introduction: NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility: Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfill 5G requirements, Enhanced Multi-RAT coordination features; Physical architecture and 5G deployment: Deployment enablers, Flexible function placement in 5G deployments.	
UNIT – 4	**5 Hrs**
Device-to-device (D2D) communications: D2D-from 4G to 5G: D2D standardization: 4G LTE D2D, D2D in 5G: research challenges; Radio resource management for mobile broadband D2D, RRM techniques for mobile broadband D2D, RRM and system design for D2D, 5G D2D RRM concept: an example; Spectrum: Introduction: Spectrum for 4G, Spectrum challenges in 5G; 5G spectrum landscape and requirements: Bandwidth requirements.	
UNIT - 5	**4 Hrs**
Security for 5G Communications: Security Issues and Challenges in 5G Communications Systems: User Equipment, Mobile Malware Attacks Targeting UE, 5G Mobile Botnets, WiFi 6	

Text Books :

1. Wireless and Mobile Network Architectures, by Yi-Bing Lin, Imrich Chlamtac,WILEY-INDIA Edition.
2. 5G Mobile and Wireless Communications Technology, Edited By Afif Osseiran,Ericsson

   Jose F. Monserrat, Patrick Marsch , Nokia
3. Fundamentals of 5G Mobile Networks, Edited by: Jonathan Rodriguez.

Reference Books :

1. Key Technologies for 5G Wireless Systems,Edited by Vincent.W.Wong, Robert Schober, Derrick Wing Kwan Ng, Li-Chun Wang,
2. Mobile Computing-Technology,Applications and Service Creation byAsoke K Talukder, Hasan Ahmed, Roopa R Yavagal, 2nd Edition, 2014, Mc Graw Hill Education
3. Mobile Communications, Jochen Schiller, 2nd Edition

MOOCS

1. https://www.coursera.org/lecture/smart-device-mobile-emerging-technologies/4-6-5g-technology-5ud4z
2. https://www.coursera.org/lecture/smart-device-mobile-emerging-technologies/4-7-5g-architecture-6KzD8
3. https://swayam.gov.in/nd1_noc20_ee61/preview

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Annotating the various architectures, rationale of 5G and system concept , research activities basic considerations,5G deployment, overview of D2D and types of communication, techniques for handling data rate and traffic flows, NSPS services, security management , overview of spectrum toolbox and WiFi6.
CO2	Interpret the various use cases and requirements of 5G, 5G functional architecture , Radio Resource Management(RRM) design, Spectrum bandwidth.
CO3	Illustrate the various strategies used in the implementation of mobile computing architecture.
CO4	Analyse the significance of 5G requirements and system concept for different usecases, mobile broadband D2D scenarios, radio resource management for multi-hop connections
CO5	Simulate wireless communication network by using modern tools and provide the analysis for the obtained results to arrive at substantial conclusions by communicating effectively as a member of diverse team.

Course Title	NATURAL LANGUAGE PROCESSING				
Course Code	20IS6PENLP	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			24

UNIT – 1	4 Hrs

Introduction: What is Natural Language Processing (NLP), Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit Distance, N-Grams, Evaluating Language Models

UNIT – 2	6 Hrs

POS tagging: English Word Classes, The Penn Treebank Part-of-Speech Tagset, Part-of-Speech Tagging, HMM Part-of-Speech Tagging, Maximum Entropy Markov Models, Bidirectionality, Part-of-Speech Tagging for Morphological Rich Languages.

Syntax Analysis: Constituency, Context-Free Grammars, Some Grammar Rules for English, Treebanks, Grammar Equivalence and Normal Form, Lexicalized Grammars, Dependency Parsing.

UNIT – 3	4 Hrs

Semantic Analysis: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Applications of the TF-IDF vector model, Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models.

UNIT – 4	6 Hrs

Statistical NLP: Naive Bayes and Sentiment Classification, Logistic Regression, Neural Network and Neural Network language models.

UNIT - 5	4 Hrs

Applications of NLP: Information Retrieval, Information Extraction, Automatic Summarization, Automatic Text categorization, Machine Translation, Speech technologies.

Text Books :

1. **Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition** by Daniel Jurafsky and James H Martin, 3rd Edition, Prentice Hall, 2019.
2. **Natural Language Processing: An information Access Perspective** by Kavi Narayana Murthy, Ess Ess Publications, 2006.1

Reference Books :

1. **Applied Text Analysis with Python** by Benjamin Bengfort, Tony Ojeda, Rebecca Bilbro, O'Reilly Media, June 2018.
2. **Natural Language Processing Recipes** by Akshay Kulkarni, Adarsha Shivananda, Apress, 2019

e-Books :

1. **Foundations of Statistical Natural Language Processing** by Christopher Manning, Hinrich Schutze, MIT Press, 2000

   https://www.cs.vassar.edu/~cs366/docs/Manning_Schuetze_StatisticalNLP.pdf
2. **Natural Language Processing with Python** by Steven Bird, Ewan Klein, Edward Loper, O'Reilly Media, June 2009.

   http://www.datascienceassn.org/sites/default/files/Natural%20Language%20Processing %20with%20Python.pdf

MOOCS:

1. Natural Language Processing by Pawan Goyal, IIT Kharagpur,

   https://swayam.gov.in/nd1_noc19_cs56/preview

2. Natural Language Processing offered by deeplearning.ai on Coursera https://www.coursera.org/specializations/natural-language-processing

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the theoretical foundations of natural language processing in linguistics and formal language theory.
CO2	Analyse NLP tasks like text pre-processing, part-of-speech tagging, syntax parsing and semantic role labelling using existing algorithms and frameworks.
CO3	Apply existing mathematical models and machine learning algorithms to build NLP applications.
CO4	Conduct experiments to implement building blocks of statistical NLP.
CO5	Evaluate language models designed to solve NLP problems.

Course Title	DEEP LEARNING				
Course Code	20IS6PEDLG	Credits	3	L-T-P	2-0-1
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			24

UNIT – 1	4 Hrs

Introduction to Artificial Neural Networks with Keras- From Biological to Artificial Neurons, Biological Neurons, Logical Computations with Neurons, The Perceptron, Multi-Layer Perceptron (MLP) and Backpropagation, Implementing MLP's with Keras, Fine Tuning Neural Network Hyper Parameters.

UNIT – 2	4 Hrs

Training Deep Neural Networks- Vanishing/Exploding Gradients, Reusing Pretrained Layers Avoiding Overfitting Through Regularization.

UNIT – 3	5 Hrs

Custom Models and Training with TensorFlow - A Quick Tour of TensorFlow, Using TensorFlow like NumPy, Customizing Models and Training Algorithms.

Loading and Preprocessing Data with TensorFlow – The Data API, The TF Record Format , Preprocessing the Input Features, TF Transform, The TensorFlow Datasets (TFDS) Project.

UNIT – 4	6 Hrs

Deep Computer Vision Using Convolutional Neural Networks - Architecture of Visual Cortex, Convolutional Layer, Pooling Layer, CNN Architectures, AlexNet, GoogLeNet Using Pre-trained Models from Keras, Classification and Localization, Object Detection, Fully Convolutional Networks.

UNIT - 5	5 Hrs

Processing Sequences Using RNNs and CNNs - Recurrent Neurons and Layers , Training RNNs, Forecasting a Time Series, Baseline Metrics , Implementing a Simple RNN , Handling Long Sequences- Tackling the Short-Term Memory Problem, LSTM Cell.

Text Book :

1. "Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems – September 2019: Second Edition" by Aurelien Geron.

Reference Book :

1."Python Machine Learning- Third Edition" by Sebastian Raschka and Vahid Mirjalili

e-Books :

1. https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/

MOOCS:

1. https://www.edx.org/course/deep-learning-with-tensorflow
2. https://www.deeplearning.ai/tensorflow-in-practice/

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Comprehend the fundamentals of deep learning algorithms.
CO2	Apply specific deep learning algorithms to obtain solutions for appropriate problems.
CO3	Identify and analyse deep learning techniques suitable for training the models using tensorflow and keras.
CO4	Conduct various experiments to demonstrate techniques using Deep neural networks, Convolutional neural networks,Recurrent neural networks so on.
CO5	Usage of modern tools for implementing deep learning algorithms using Python.
CO6	Communicate effectively in a team and investigate on the topics related to deep learning algorithms.

Course Title	DIGITAL IMAGE PROCESSING				
Course Code	**20IS6PEDIP**	**Credits**	**3**	**L-T-P**	**2-0-1**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lecture Hours**			**24**

UNIT – 1	4 Hrs
Fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: Image sampling and quantization, basic relationships between pixels. Basic intensity transformation functions, histogram processing.	
UNIT – 2	**5 Hrs**
Fundamentals of spatial filtering, smoothing and sharpening spatial filters. Basics of filtering in the frequency domain, Image smoothing using lowpass frequency domain filters, Image sharpening using Highpass filters.	
UNIT – 3	**5 Hrs**
A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering. Color image processing: Color fundamentals, Basics of full-color image processing, Color transformations, Color image smoothing and sharpening.	
UNIT – 4	**5 Hrs**
Image compression: Huffman Coding, Arithmetic Coding, LZW coding, Run-length coding, Bit-plane coding, Block transform coding, Wavelet coding.	
UNIT - 5	**5 Hrs**
Morphological image processing: Erosion and dilation, opening and closing, hit or miss transformation, basic morphologic algorithms. Image Segmentation: Point, line and edge detection:-Detection of isolated points, Line detection, Edge models, Basic edge detection. Segmentation by region growing, Region splitting and merging.	

Text Book :

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, 4th Edition, Pearson Education, 2018.

Reference Books :

1. Anil K Jain, Fundamentals of Digital Image Processing, Pearson Education, 2015.
2. Digital Image Processing, Jayaraman S, Veerakumar T, Esakkirajan S, McGraw Hill Education, 2017.

e-Books :

1. Image Processing Principles and Applications, Tinku Acharya and Ajoy K Ray,

Wiley Publications, www.cs.ukzn.ac.za/~sviriri/Books/Image-Processing/book4.pdf

2. Image Processing, https://person.dibris.unige.it/rovetta-stefano/rad/image-processing-wikipedia-book.pdf

MOOCS

1. Fundamentals of Digital Image and Video Processing,
   https://www.coursera.org/learn/digital
2. Digital Image Processing,
   https://www.classcentral.com/course/swayam-digital-image-processing-14005

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Understand the fundamentals of sampling, filtering, restoration, color transformations, compression, morphology and segmentation.
CO2	Apply image processing concepts of filtering in spatial and frequency domains.
CO3	Assess the algorithms and techniques for image compression and segmentation.
CO4	Deduce mathematical transforms for processing of images in terms of sampling and intensity functions.
CO5	Articulate on color transformations, restoration process, coding techniques and morphological algorithms.
CO6	Develop code patterns by exploring image processing algorithms to arrive at effective solutions.

Course Title	DATA STRUCTURES AND ALGORITHMS				
Course Code	20IS6OEDSA	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	7 Hrs

Introduction to Data Structures: Definition and its classification, Dynamic Memory Allocation

Linked List: Definition, Operations on Singly linked list, Doubly linked list, Circular linked list, Applications of Linked list**.**

UNIT – 2	7 Hrs

Stacks: Definition, Stack Operations, Infix to Postfix, Evaluation of postfix

Recursion: Factorial, Fibonacci, Tower of Hanoi

Queues: Definition, Queue operations, Circular queue, Dequeue

UNIT – 3	8 Hrs

Binary Search Trees: Definition, Traversals, Insertion, Deletion, Applications

Fundamentals of Algorithm Analysis: Framework for Analysis of algorithm efficiency, Asymptotic Notations, Mathematical Analysis of Non recursive algorithms and Recursive algorithms.

UNIT – 4	7 Hrs

Brute Force: Bubble Sort and Selection Sort

Divide and Conquer: Merge sort, Quicksort

Decrease and conquer: Depth First Search (DFS), Breadth First Search (BFS), Topological Sorting

UNIT - 5	7 Hrs

Transform and Conquer: Heaps and Heap sort

Space and Time Trade-offs: Hashing

Dynamic Programming: Computing a Binomial Coefficient, Floyd's Algorithm, Knapsack Problem and Memory functions.

Text Books :

1. **Data Structures using C and C++** by Yedidyah, Augenstein, Tannenbaum, 2nd Edition, Pearson Education, 2015
2. **Introduction to the design and analysis of algorithms** by Anany Levitin, third Edition, Pearson Education, 2017

Reference Books :

1. **Introduction to Algorithms**, Cormen T.H, Leiserson C. E, Rivest R.L, Stein C, 3rd Edition, PHI 2010.
2. **Data Structures and Algorithm Analysis in C++,** by Mark Allen Weiss, 3rd Edition, Pearson Education, 2007.

e-Books :

1. https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf
2. https://www2.cs.duke.edu/courses/fall08/cps230/Book.pdf

MOOCS

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://www.coursera.org/learn/algorithms-part1

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Apply principles of Data Structures and Algorithm design techniques for solving problems.
CO2	Analyse and develop operations on linear and non-linear data structures.
CO3	Analyse the time complexity of different algorithms.
CO4	Design solutions to computing problems using appropriate data structures and algorithm design techniques.
CO5	Demonstrate data structure and algorithms coding skills on a competitive programming platform.

Course Title	ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT				
Course Code	20IS6OERPA	Credits	3	L-T-P	3-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	8 Hrs

Introduction to RPA: What is RPA?, Why RPA?, Automation Vs RPA, Programming Constructs of RPA, Types of Robots in RPA, Benefits of RPA, RPA development Methodologies, RPA Process.

The User Interface: Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables -Number Variables - Array Variables - Date and Time Variables - Data Table Variables – Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces.

UNIT – 2	7 Hrs

RPA Control Flow and Activities

Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow – Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity -The Switch Activity - The While Activity - The For Each Activity - The Break Activity**.**

UNIT – 3	6 Hrs

Data Manipulation

Data Manipulation Introduction - Scalar variables, Collections and Tables – Text Manipulation - Data Manipulation - Gathering and Assembling Data.

UNIT – 4	7 Hrs

Advanced Automation Concepts and Techniques

UI Interaction, Desktop and Web recording, Web scraping, Data scrapping, Types of selectors, Image and Text Automation, Data Tables, Excel and PDF operations.

UNIT - 5	7 Hrs

Exception Handling and Orchestration

Debugging Tools, Exception Handling, Types of Exceptions, Workflow Designs, Catching Errors Mechanisms, Introduction to Orchestrator, Process and Robots in Orchestrator, Working with Orchestrator.

Text Book:

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

Reference Books :

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: A Primer, Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant.
3. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.

e-Books :

1. https://www.uipath.com/rpa/robotic-process-automation

MOOCS

1. https://www.uipath.com/rpa/academy/training
2. https://www.uipath.com/developers/guides-and-resources
3. https://www.uipath.com/developers/video-tutorials
4. https://academy.uipath.com/learn

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Describe RPA, where it can be applied and how its implemented.
CO2	Apply various control and activity flow mechanisms that bound the automation process.
CO3	Perform data manipulation operations and exception handling mechanisms.
CO4	Independently design and create robots for business processes for automating desktop and web applications.
CO5	Implement Orchestration process for automating robots.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
(Autonomous Institute, Affiliated to VTU)
DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**MULTI-DISCIPLINARY PROJECT**				
Course Code	**20IS6PWMPR**	**Credits**	**2**	**L-T-P**	**0-0-2**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**4**	**Total Lab Hours**			**48**

The project must be implemented by a team of students with different engineering streams on a recent technology. The students would be identifying a problem, proposing and implementing a solution which lies in the multidisciplinary area and has a societal impact. The students must make a regular presentation of their work to the internal guides and report their progress of the project.

- The Problem formulation and submission of synopsis need to be done within 4 weeks from the commencement of the 6th semester.
- Continuous evaluation would be done in two or three phases based on the rubrics which would be finally evaluated to 50 marks.
  - o Review 1 – 10 Marks
  - o Review 2 – 15 Marks
  - o Review 3 – 25 Marks

Total internal assessment for the project would be 50 Marks. SEE will be conducted for 50 Marks. The final marks would be CIE+SEE (50+50) =100 Marks

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO1	Identify the problem in the given domain through literature survey by acquiring the depth knowledge of the chosen domain.
CO2	Analyze the identified problem in the given domain with a set of potential solutions.
CO3	Design and implement an effective solution to achieve the objectives of the identified problem.
CO4	Apply latest components and modern engineering tools.
CO5	Investigate, analyze, interpret data and results to arrive at valid conclusions.
CO6	Identify the community that shall benefit through the proposed solution and demonstrate the need for sustainable development.

CO7	Contribute effectively as a member or as a leader in a team throughout the Software development process.
CO8	Communicate clearly, write effective reports and make effective presentations following the professional code of conduct and ethics.

(Autonomous Institute, Affiliated to VTU)

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Course Title	**SEMINAR BASED ON SUMMER/WINTER INTERNSHIP**				
Course Code	**20IS6SRITR**	**Credits**	**1**	**L-T-P**	**1-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		

Technical Seminar is based on :

    i. Summer/Winter Internship work done during the vacation period of 4th or 5th Semester.

(or)

ii. Review / Implementation of Research paper of recent Technology trends.

The seminar topics should be chosen after referring to IEEE / ACM/ Springer/ Elsevier/ Science Direct/ Transaction journals. The students should refer to minimum 15 papers of the chosen topic.

The students must make a presentation on the scheduled dates and this will be evaluated by the internal committee based on the rubrics for 25 Marks. Finally, the students must submit a technical seminar report and it will be evaluated for 25 marks by the internal committee based on the seminar rubrics. Total internal assessment for the seminar would be 25+25=50 Marks. SEE will be conducted for 50 Marks The final marks would be CIE+SEE (50+50) = 100 Marks.

COURSE OUTCOMES (COs)

At the end of the course, the student will be able to

CO 1	Acquire theoretical knowledge in industry perspective and competent professionals for industry.
CO 2	Apply the concepts with current technological developments relevant to subject area of training.
CO 3	Impart skills in writing technical reports describing projects and results.
CO 4	Effectively communicate by making presentations of their work.
CO 5	Understand the social and administrative considerations that influence the working environment of industrial organizations.
CO 6	Expose the students to future employers and develop their skills for lifelong learning/job.