BMS COLLEGE OF ENGINEERING, BENGALURU-19

(Autonomous Institute, Affiliated to VTU)

BACHELOR OF ENGINEERING

DEPARTMENT
OF
INFORMATION SCIENCE AND ENGINEERING

SCHEME & SYLLABUS

III - VIII SEMESTERS

(Academic Years: 2019-22)

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

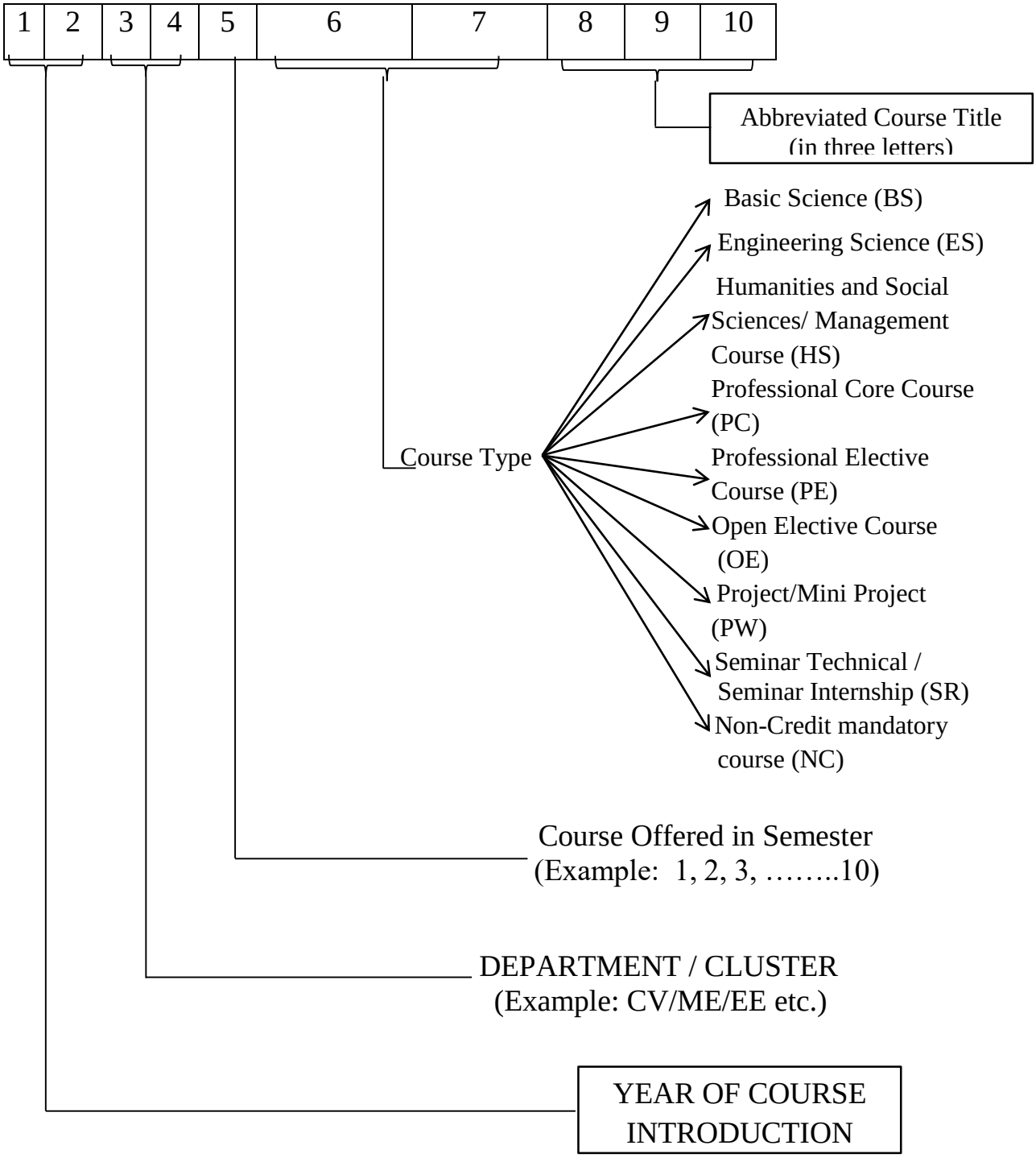
PROGRAMME SPECIFIC OUTCOMES (PSOs)

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



Scheme of Instructions

Semester – III

(With effect from the Academic Year 2020-21)

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	1	0	0	1	50	50	100
HS-2	20HS4ICSKN/ BKN	Kannada Language	1	0	0	1	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

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

Course Type	Course Code	Course Title	Credits			Total Credits	Marks		
			L	T	P		CIE	SEE	Total
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-3	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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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 IT Engineers	2	0	0	2	50	50	100
HS-5	20IS7HSCLE	Cyber Law for Engineers	3	0	0	3	50	50	100
PE-5	20IS7PEBLT	Blockchain Technology	0	0	2	2	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	20IS7PCISF	Information Security and Forensic	3	0	1	4	50	50	100
NC-7	20IS7NCPDC	Personality Development and Communication/Aptitude Skills	Non-credit mandatory Course						
TOTAL			13	0	6	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

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 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

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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	7 Hrs
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-d88QCConstitution 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 Lecture 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).

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	**11 Hrs**
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 real 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 Books:

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 Lecture 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_29e7da728d3e4beebb5a7bd87c55834b_file-module-slides-8-security.pdf?Expires=1596672000&Signature=gfbAJPaJmlJJAyUzVY7nVFXd2NpDyQyFK~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=ZGVmYXVsdGRvbWFpbnxkcmdtYnVrY3xneDo0YzkwNDkwYWFkOGJhMDE
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	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:

1. http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000023MA/P001403/M016044/ET/1465204830Module-24Quadrant-I.pdf
2. https://www.fingerprintforsuccess.com/blog/entrepreneur-resources
3. https://managementhelp.org/startingorganizations/starting-business.htm
4. 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.

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	Total Lecture 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/HandbookOfDataMining.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 Books:

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
3. 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	5 Hrs

Introduction, Purpose of the *PMBOK*, What is a Project?, The Relationships Among Portfolios, Programs, and Projects, What is Project, Management?, Relationships 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, Project Stakeholders and Governance, Project Stakeholders, Project Governance, Project Success

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.

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.

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

Create WBS-Create WBS: Inputs, Create WBS: Tools and Techniques, Create WBS: 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

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

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

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

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 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

UNIT - 5	**4 Hrs**

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

Text Books:

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

Reference Books:

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 Books:

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).

4.

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 Books:

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
4.

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 Books:

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, JohnWiley, 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**
Basics of Mobile Computing - Seeding of 1G, Digitization with 2G, Mobile Internet with 3G, Faster Mobile Networks with 4G, Future Networks with 5G	
UNIT – 2	**5 Hrs**
Rationale of 5G, 5G Targets, Typical Mobile Architecture, 5G New Radio, Millimeter Waves, Beamforming, Multiple Access, Antenna and MIMO, Cellular Call Handoffs, CDMA, Circuit Switched, Packet Switched Networks,	
UNIT – 3	**5 Hrs**
5G Technology Enablers Basics - Data Centers, Virtualization, Microservices, Cloud Native, Containers, Dockers, Orchestration, Automation, SDN, Infrastructure as Code, Dockers. DevSecOps, CI/CD Pipeline, Jenkins, Terraform, Ansible, Puppet, SRE.	
UNIT – 4	**5 Hrs**
5G Deployment Architecture - SA and NSA, 5G Core Architecture - Service Based Architecture, Point-to-Point Interface, O-RAN, C-RAN, v-RAN 5G Core Elements - Access and Mobility Function, Session Management Function, User Plan Function, Network Repository Function, Unified Data Management Function, AUSF, EIR, Policy Control Function, Identifiers in 5G, Call Flows	
UNIT - 5	**4 Hrs**
Security in 5G - Security in 5G, Software Architecture, Application Performance, Interconnecting with 5G	
Text Books:	
Reference Books:	
e-Books:	
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	
Assignments/Discussion: ● How 5G and IoT impact Auto Industry	

- 6G and Beyond
- Wi-Fi6 vs 5G
- Health Concerns of 5G - Will it be bad for our health ?
- Programmable Networks
- Edge Computing and 5G

Lab Work:

- 5G Network / Core Simulation
  - Python-Based
    - https://github.com/rodrigo-tinini/5GPy
    - https://pypi.org/project/sim2net/
  - R-based 5G Infra Generator
    - https://github.com/MartinPJorge/mec-generator/tree/5g-infra-gen
    - Study above R-based simulator and convert it into a Python-based simulator.
- NFV Services
  - Demonstrate DNS/DHCP/IDS Services using Faucet
    - Install OpenSwitch http://www.openvswitch.org/
    - Use Faucet https://docs.faucet.nz/en/latest/intro.html
    - NFV Services Tutorial using Faucet https://docs.faucet.nz/en/latest/tutorials/nfv_services.html#
- REST APIs and Principles
  - 5G API Use Case-1: Establish Packet Data Unit
  - 5G API Use Case-2: Access Subscriber Information
- Reference
  - https://github.com/calee0219/awesome-5g

○ https://github.com/cerob/slicesim	
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	50marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			24

UNIT – 1	4 Hrs
Introduction: Knowledge in speech and language processing, Ambiguity, Models and Algorithms, Language, Thought and Understanding, The State of the Art. **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 **Syntax Analysis:**Constituency, Context-Free Grammars, Some Grammar Rules for English, Treebanks, Grammar Equivalence and Normal Form, Lexicalized Grammars, Dependency Parsing	
UNIT – 3	**6 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	**4 Hrs**
Learning to Classify Text: Supervised Classification, Evaluation, Decision Trees, Naive Bayes Classifier, Maximum Entropy Classifiers, Modeling Linguistic Patterns	
UNIT - 5	**4Hrs**
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 with Python** by Steven Bird, Ewan Klein, Edward Loper, O'Reilly Media, June 2009.
3. **Natural Language Processing: An information Access Perspective** by KaviNarayana Murthy, EssEss Publications, 2006.

Reference Books :

1. **Natural Language Processing: Python and NLTK** by Deepti Chopra, Jacob Perkins, and NitinHardeniya, Packt Publishing, Nov 2016.
2. **Natural Language Processing Recipes** by AkshayKulkarni, AdarshaShivananda, Apress, 2019

e-Books :

1. **Foundations of Statistical Natural Language Processing** by Christopher Manning, HinrichSchutze, MIT Press, 2000https://www.cs.vassar.edu/~cs366/docs/Manning_Schuetze_StatisticalNLP.pdf
2. **Applied Text Analysis with Python** by Benjamin Bengfort, Tony Ojeda, Rebecca Bilbro, O'Reilly Media, June 2018. https://github.com/Jessinra/READING-Data-Science-II/blob/master/Applied%20Text%20Analysis%20with%20Python.pdf

MOOCS

1. Natural Language Processing by PawanGoyal, IIT Kharagpur,https://swayam.gov.in/nd1_noc19_cs56/preview
2. Natural Language Processing offered by deeplearning.ai on Courserahttps://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 Books:

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 Books:

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 Books:

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 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	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.

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

CO1	Acquire theoretical knowledge in industry perspective and competent professionals for industry.
CO2	Apply the concepts with current technological developments relevant to subject area of training.
CO3	Impart skills in writing technical reports describing projects and results.
CO4	Effectively communicate by making presentations of their work.
CO5	Understand the social and administrative considerations that influence the working environment of industrial organizations.
CO6	Expose the students to future employers and develop their skills for lifelong learning/job.

Course Title	BIOLOGY FOR IT ENGINEERS				
Course Code	20IS7BSBIO	Credits	1	L-T-P	1-0-0
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	1	Total Lecture Hours			16

UNIT – 1	4 Hrs

Basic Neuroscience: Neurons, Action Potentials or Spikes, Dendrites and Axons, Synapses, spike Generation, Adapting the Connections: Synaptic Plasticity, LTP, LTD, STDP, Short-Term Facilitation and Depression, Brain Organization, Anatomy, and Function, Recording and Stimulating the Brain: Recording Signals from the Brain, Invasive Techniques, Noninvasive Techniques., Stimulating the Brain, Simultaneous Recording and Stimulation.

UNIT – 2	3 Hrs

Computational biology: Duality of Goals: Foundations and Frontiers, Duality of disciplines: Computation and Biology, Why Computational Biology? Finding Functional Elements: A Computational Biology Question, Molecular Biology: The Central Dogma of Molecular Biology, DNA, Transcription. RNA, Translation, Protein, Regulation: from Molecules to Life, Metabolism, Systems Biology, Synthetic Biology, Model organisms and human biology.

UNIT – 3	3 Hrs

Computational Genomics: Introduction to Genomics, Genes, DNA and central dogma, Genome, gene, controlled genes, transcriptional and the post-transcriptional regulation Elements of gene regulation, Transcriptional regulation, Post-transcriptional regulation, Shaping the genome: DNA mutation, High-throughput experimental methods in genomics The general idea behind high-throughput techniques, High-throughput sequencing, Visualization and data repositories for genomics

UNIT – 4	2 Hrs

DNA Computing structure and processing: Structure of DNA, Operations on DNA molecules, reading out the sequences, Molecular computing: Adleman's experiment, Satisfiability problem, Break DES code, Paradigm of DNA computing, Hopes and warnings of DNA computing.

UNIT - 5	2 Hrs

Genetic Algorithms: An Overview, A brief history of evolutionary computation, the appeal of evolution, biological terminology, search spaces and fitness landscapes, elements of genetic algorithms, Examples of Fitness Functions, GA Operators, a simple genetic algorithm, genetic algorithms and traditional search methods, two brief examples, Using GAs to Evolve

Strategies for the Prisoner's Dilemma, Hosts and Parasites: Using GAs to Evolve Sorting Networks, how do genetic algorithms work?
Text Books : 1. Brain-Computer Interfacing, An Introduction, Rajesh P N Rao, Cambridge University Press, 2013 2. DNA Computing: New Computing Paradigms Rozenberg, Grzegorz, Paun, Gheorghe, Springer, 1998 3. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 1998 4. Computational Biology: Genomes, Networks, Evolution, Manolis Kellis, MIT Press 2016 5. Computational Genomics with R, Altuna Akalin, Chapman and Hall/CRC, 2020

Course Title	CYBER LAW FOR ENGINEERS				
Course Code	20IS7HSCLE	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	8 Hrs
Understanding computers, Internet and Cyber laws: Modern Era, Need for cyber Laws, Historical Perspective, The Character and Use of Internet technologies. Conceptual Framework of E-Commerce: E-Governance: What is E-Commerce, Various modes, Mechanism involved in the operation of Internet, Type of Players, Web Development and hosting Agreements, Web Hosting, The Problem of Internet Jurisdiction, Illustrative cases about Cyberspace Jurisdiction. The Role of Electronic Signatures in E-Commerce with Reference to Free Market Economy in India	
UNIT – 2	**7 Hrs**
Legal aspects of Electronic Records/Digital Signatures: Recognition of electronic records, Positions in US, Australia , The Legal recognition of electronic /digital signatures, electronic records and electronic signatures/digital signatures and their use by the government and its agencies in India, retention of electronic records in India, UNCITRAL Model Law on attribution of data Messages, Positions in US, India, The central government's power to make rules in India, Electronic records, Attribution acknowledgement and dispatch in India, Acknowledgement of receipt of electronic record in India, UNCITRAL Model Law relating to Acknowledgement of Data Messages, the time and place of dispatch and receipt of electronic records in India, securing electronic record and electronic/digital signatures in India, Verification of electronic signatures in India. The roles and regulations of certifying authorities in India	
UNIT – 3	**6 Hrs**
Protection of Intellectual Property Rights in Cyberspace in India: The cyberspace, the relevance of domain names in intellectual property rights, deception by squatting in cyberspace, bad faith in relation to domain name infringement, some leading cases involving complaints from India before WIPO, protection of copyright on cyberspace, rights of software copyright owners, infringement of copyright on cyberspace, cyberspace, the internet, websites and the nature of the copyright, linking, hyperlinking and framing, remedies for infringement of copyright on cyberspace, the liabilities of an Internet Service Provider (ISP) in cyberspace, cyberspace and protection of patents in India, patents as a form of Intellectual Property.	
UNIT – 4	**7 Hrs**
Penalties compensation and adjudication of violations of provisions of IT ACT and judicial review: Penalty and compensation for damage to computer, computer system, compensation for failure to protect data, penalty for failure to furnish information, return or any other penalty, adjudication of disputes under the IT Act, cyber appellate tribunal, its functions and powers under the IT act, compounding of contraventions and recovery of penalty or	

compensation, appeal to the high court under the IT act and judicial review under the constitution of India Some important offences under the Cyberspace Law and the Internet in India: Obscenity and Pornography on Cyber space, Hacking on the Cyberspace and Internet, Other Offences – computer resource, Violation of the Right of Privacy on Cyberspace Internet, Punishment for Violation of Privacy, Breach of Confidentiality and Privacy under the IT Act, Terrorism on Cyber Space/Internet.

UNIT - 5	**8 Hrs**

Other Offences under the Information Technology Act in India, Power to Issue directions for interception or monitoring or decryption of information, Power to issue directions for blocking for public access of any information,
Punishment for Abetment and Attempt to Commit Offences under the IT Act, Commission of Offences by Companies under the IT Act, The Power of Police Officer and other Officers to Enter and Search, Protection of Actions taken in a good faith, Some Amendments made under the Indian penal Code by IT(Amendment) Act, 2008. Role of electronic evidence and the miscellaneous provisions of the IT act.

Text Books :

1. Cyber Laws and IT Protection by Harish Chander, Eastern Economy Edition, PHI Learning Private Limited, 2012.
2. Cyberlaw-The Indian Perspective by Pavan Duggal, 2009 Edition.

Reference Books :

1. Cyber law in India by Satish Chander, ABS books, Edition 1, 2017
2. Textbook on Cyber Law by Pavan Duggal, Universal Publications, 2nd edition , 2016.

e-Books :

1. http://elib.bvuict.in/moodle/pluginfile.php/163/course/section/79/Cyber%20Law%20-%20Trends%20and%20Developments%20in%20India.pdf3.
2. http://osou.ac.in/eresources/introduction-to-indian-cyber-law.pdf

MOOCS

1.https://www.coursera.org/learn/cyber-security-domain

Course Title	BLOCKCHAIN TECHNOLOGY				
Course Code	20IS7BSBCT	Credits	2	L-T-P	0-0-2
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			48

About the Course: The students will Introduced to the Blockchain Technology, architecture Security features with Cryptography essentials, usecases and tools. The course would include two project phases.

During Phase 1, students would learn the solidity language and be able to build a Blockchain application using Ethereum

In Phase 2, students will be introduced with permissioned Blockchain using Hyperledger

Text Books :

1. Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, Bikramaditya, Singhal Gautam Dhameja, Priyansu Sekhar Panda, APress, ISBN-13 (pbk): 978-1-4842-3443-3 ISBN-13 (electronic): 978-1-4842-3444-0, https://doi.org/10.1007/978-1-4842-3444-0
2. BlockChain by Example, Development guide for creating decentralized applications using Bitcoin, Etereum and Hyperledger, Bellaj Badr. Richard Horrocks & Xun(Brion) Wu. Packt
3. Blockchain, IBM Limited Edition, by Manav Gupta. Published by John Wiley & Sons, Inc., 111 River St., Hoboken, NJ 07030-5774, www.wiley.com

Reference Books :

1. Mastering Blockchain, Imran Bashir, Packt>
2. Hands-On Blockchain with Hyperledger: Building decentralized applications with Hyperledger Fabric and Composer by Nitin Gaur (Author), Luc Desrosiers, Venkatraman Ramakrishna, Petr Novotny, Salman A. Baset.

e – Books :

1. Hyperledger Fabric In-Depth: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric (English Edition) Kindle Edition, https://www.amazon.in/Hyperledger-Fabric-Depth-Blockchain-Applications-ebook/dp/B08CRMLV99?source=ps-sl-shoppingads-lpcontext&psc=1 : Code-bundle https://rebrand.ly/cbgth5m
2. Mastering Hyperledger Fabric: Master The Art of Hyperledger Fabric on docker, docker swarm and Kubernetes by Narendranath Reddy

MOOCs

1. Courseera-link

   https://www.coursera.org/programs/bms-college-of-engineering-on-coursera-jcigy?currentTab=CATALOG

2. BlockChain Basics

   https://www.coursera.org/programs/bms-college-of-engineering-on-coursera-jcigy?collectionId=6ccyf&currentTab=CATALOG&productId=flsycYzjEeeTABKJlsHMCA&productType=course&showMiniModal=true

3. Transacting on Block-chain - https://www.coursera.org/programs/bms-college-of-engineering-on-coursera-jcigy?collectionId=6ccyf&currentTab=CATALOG&productId=INwJmyYkEemBxQoEr_JuHA&productType=course&showMiniModal=true

Course Title	DEVOPS				
Course Code	21IS7PEDVR	Credits	2	L-T-P	0-0-2
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			48

About the Course: The students will learn the fundamentals of DevOps framework. The course would include two lab cycles and a project work.
During Cycle 1, students would be able to build CI/CD pipeline using Git and Jenkins.
In cycle 2, students will be exposed to containerization with Docker and Kubernetes. They will also be able to use Grafana to setup a monitoring solution for an application.
In the project phase, student teams will work to build an application and deploy the same to an environment using DevOps tools.

Reference Books / e-Books:

1. Accelerate: The Science of Lean Software and DevOps, Nicole Forsgren, Jez Humble, and Gene Kim, IT Revolution, 2018
2. The DevOps Handbook, Gene Kim, Jez Humble, Patrick Debois, and John Willis, IT Revolution, 2016
3. The DevOps 2.0 toolkit: Automating the Continuous Deployment Pipeline with Containerized Microservices, Viktor Farcic, 2016
4. Cloud Native DevOps with Kubernetes, John Arundel and Justin Domingus, O'Reilly, 2019

MOOCS

1.https://www.edx.org/professional-certificate/linuxfoundationx-introduction-to-devops-practices-and-tools

2. https://www.coursera.org/learn/version-control-with-git

3. https://www.coursera.org/learn/continuous-integration

4. https://www.coursera.org/learn/kubernetes-deployment

Course Title	DATA VISUALIZATION AND REPORTING				
Course Code	21IS7PEDVR	Credits	2	L-T-P	0-0-2
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	4	Total Lecture Hours			48

About the Course: The students should work with given dataset and create effective visualizations. The course will be executed in two cycles and a project work.
During Cycle 1, the students would be able to implement the key visualization techniques using Python tools like Matplotlib, Seaborn etc.
In Cycle 2, students will be exposed to industry-standard software tools like Tableau, Google Data Studio etc. to create compelling and interactive visualization of various types of data.
In the Project work phase, student teams will work to build and evaluate visualization systems.

Text Books :

1. Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Embarak, D. O, Germany: Apress, 2018

2. Pro Tableau: A Step by Step Guide, Seema Acharya, Subhashini Chellappan, Apress, 2016

Reference Books :

1. Python Data Visualization Cookbook, Igor Milovanović , Dimitry Foures , Giuseppe Vettigli, 2nd Edition 2015

2. Practical Tableau, Ryan Sleeper, , O'Reilly, 1st Edition,2018

e-Books :

1. Data Visualization with Python and JavaScript, Kyran Dale, O'Reilly,2016

https://dev.seperians.es/libros/Data%20Visualization%20with%20Python%20%26%20Js.pdf

2. Jumpstart Tableau: A Step-by-Step Guide to Better Data Visualization, Arshad Khan, Apress, 2016

https://download.e-bookshelf.de/download/0007/6068/31/L-G-0007606831-0014536440.pdf

MOOCS

1. https://www.coursera.org/learn/python-for-data-visualization
2. https://www.udacity.com/course/data-visualization-in-tableau--ud1006

Course Title	VIRTUAL AND AUGMENTED REALITY				
Course Code	20IS7PEVRR	Credits	2	L-T-P	0-0-2
CIE	50 Marks	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	1	Total Lecture Hours			16

During the Cycle 1, Using any of the open source AR-VR SDKs, students will

I. Demonstrate the following VR principles
   1. Locomotion
   2. Object Interaction
   3. Rendering and lighting
   4. Menus and virtual controls

II. Demonstrate the VR View for the Web

III. Build and demonstrate a simple video player within VR

IV. Build hybrid application that switches between 2D and VR at runtime.

V. Demonstrate magic window that uses the device's built-in orientation sensor to match the virtual camera's rotation to that of the device.

VI. Demonstrate immersive user experience quality by maintaining the head tracker.

VII. Build an application for video 360^{o} experience

VIII. Demonstrate see-through mode feature by adding augment reality experiences to users' experiences.

IX. Demonstrate Discover Resonance Audio

X. Create a simple blocks of 3D model

In the project phase, student teams will work to build an virtual/augment reality application.

Text Books :

1. Virtual Reality Technology, 2nd Edition, Grigore C. Burdea, Philippe Coiffet, Wiley Press, 2013
2. Augmented Reality: Principles & Practice, Dieter Schmalstieg and Tobias Höllerer Pearson Education India, 2016

Reference Books :

1. Virtual Reality, Steven M. LaValle. Cambridge University Press, 2017
2. Understanding Augmented Reality, Concepts and Applications, Alan B. Craig, Morgan Kaufmann, 2013

Course Title	JAVA PROGRAMMING				
Course Code	20IS7OEJVP	Credits	3-0-0	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	5 Hrs
An Introduction to Java, Why Is Java Portable? Understand Java's contribution to the Internet, Understand the importance of bytecode, Object-Oriented Programming, Encapsulation, Polymorphism, Inheritance, Preparing Your Development Environment, Installing Java, The JAVA_HOME Environment Variable, Installing a Java IDE, Java Fundamental Building Blocks.	
UNIT – 2	**10 Hrs**
Java Syntax, Base Rules of Writing Java Code, Package Declaration, Import Section, Java "Grammar", Java Comments, Java Object Types, Classes, Fields, Class Variables, Encapsulating Data, Methods, Constructors, Abstraction, Enums.	
UNIT – 3	**10 Hrs**
Introduction to Java Data Types, Primitive Data Types, The Boolean Type, the char Type, Integer Primitives, Real Primitives, Reference Data Types, Arrays, The String Type, Escaping Characters, Wrapper Classes, Date Time API, Collections, Program Control Statements, Input characters from the keyboard, Know the complete form of the if statement, Use the switch statement, Know the complete form of the for loop,Use the while loop, Use the do-while loop, Use break to exit a loop, Use break as a form of goto, Apply continue, Nestloops.	
UNIT – 4	**5 Hrs**
Interfaces, Differences between Abstract Classes and Interfaces in Java, Default Methods, Annotation Types, Generics. Java Reserved Words.	
UNIT - 5	**6 Hrs**
Exception Handling, Know the exception hierarchy, Use try and catch, Understand the effects of an uncaught exception, Use multiple catch statements, Nest try blocks, Throw an exception, Use finally, Use throws, Create custom exception classes.	

Text Books :

1. Java for Absolute Beginners_ Learn to Program the Fundamentals the Java 9+ Way, Iuliana Cosmina, Edinburgh, UK, 2018, ISBN-13 (pbk): 978-1-4842-3777-9, ISBN-13 (electronic): 978-1-4842-3778-6.
2. Java A Beginner's Guide, Eighth Edition, Herbert Schildt,ISBN:978-1-26-044022-5 Oracle Press.ISBN:978-1-26-044021-8,MHID:1-26-044021-4(print version).

Reference Books :

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.

e-Books :

1. https://www.pdfdrive.com/java-java-programming-for-beginners-a-simple-start-to-java-programming-e186416077.html.
2. https://www.pdfdrive.com/learn-java-8-in-a-week-a-beginners-guide-to-java-programming-e188445398.html

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 Title	MACHINE LEARNING				
Course Code	20IS7OEMLG	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
Learning: Well-posed learning problems, Designing a learning system, Perspectives and Issues in Machine Learning, Concept Learning, Find-S: Finding a maximally specific hypothesis, Version spaces and the candidate-elimination algorithm, Remarks.	
UNIT – 2	**8 Hrs**
Decision Trees: Decision Tree Representation, Appropriate problems for decision tree learning, The Basic decision tree learning algorithm, Hypothesis space search, Inductive bias and Issues in Decision Tree learning.	
UNIT – 3	**7 Hrs**
Artificial Neural Networks: Neural Network Representation, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and Backpropagation algorithm, Remarks.	
UNIT – 4	**7 Hrs**
Bayesian and Computational Learning: Bayes Theorem, Bayes Theorem Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier.	
UNIT - 5	**7 Hrs**
Instance Based Learning and Learning set of rules: K- Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning. Sequential Covering Algorithms, Learning Rule Sets, Learning First Order Rules, Learning Sets of First Order Rules.	

Text Books:

1. Machine Learning by Tom M Mitchell, McGraw-Hill Education, Indian Edition, 2016.

Reference Books:

1. Introduction to Machine Learning 3rd Edition by Ethem Alpaydin, PHI, 2015.
2. Machine Learning in Action by Peter Harrington, Manning Publications, 2012.

e-Books:

1. http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf
2. http://alex.smola.org/drafts/thebook.pdf

MOOCS

1. https://www.coursera.org/learn/machine-learning
2. https://www.udacity.com/course/intro-to-machine-learning--ud120

Course Title	**TECHNICAL SEMINAR (Based on review of Research Publication/ Patent)**				
Course Code	**20IS7SRTLS**	**Credits**	**1**	**L-T-P**	**1-0-0**
CIE	**50 Marks**	**SEE**	**50 Marks**		
Contact Hours / Week	**2**				

Technical Seminar is based on:

Review / Implementation of Research paper / Patent 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 at least 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. 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 Title	**INDUSTRY MOTIVATED COURSE**				
Course Code		**Credits**	**1**	**L-T-P**	**1-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**1**	**Total Lecture Hours**			**16**

About the Course: A series of lecture sessions will be arranged by Industry experts. Faculty coordinator who will be in-charge for this course will plan for the sessions after talking to experts from Industry, attend all the sessions and coordinate in evaluating the students.

Course Title	INFORMATION SECURITY AND DIGITAL FORENSICS				
Course Code	20IS7PCIST	Credits	4	L-T-P	3-0-1
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3+2 = 5	Total Lecture Hours			36

UNIT – 1	7 Hrs

Security Technology: Firewalls and VPNs – Introduction, Access control, Firewalls-Firewall processing modes, firewall structure, firewall architectures, selecting the right firewall, configuring and managing firewalls, Protecting Remote connections.

UNIT – 2	8 Hrs

Security technology: Intrusion detection and prevention systems and other security tools: Introduction, Intrusion detection and prevention systems, Honeypots, honeynets and padded cell systems, scanning and analysis tools, Biometric access controls.

UNIT – 3	8 Hrs

Network Forensics and Investigating Logs: Introduction to Network Forensics and Investigating Logs. Network Forensics: Analyzing Network Data, The Intrusion Process, Looking for Evidence, End-To-End Forensic Investigation. Log files as evidence: Legality of Using Logs, Examining Intrusion and Security Events, Using Multiple Logs as Evidence, Maintaining Credible IIS Log Files, Importance of Audit Logs.

UNIT – 4	7 Hrs

Investigating Network: Introduction to Investigating Network Traffic, types of network attacks, why investigate Network Traffic. DNS Poisoning Techniques, Evidence gathering from ARP Table, Evidence gathering at Data Link Layer: DHCP. Documenting the Evidence Gathered on a Network, Evidence Reconstruction for Investigation.

UNIT - 5	6 Hrs

Investigating web attack: Indications of a web attack, types of web attacks: Cross Site Scripting, Cross Site Request Forgery, Code Injection Attacks, Parameter Tampering, Cookie Poisoning, Buffer Overflow, Cookie Snooping. Security Strategies for Web Application, Investigating Static and Dynamic IP Addresses, Checklist for Web Security.

Text Books :

1. Principles of Information SecurityPaperback , Michael E Whitman , Herbert J Mattord, Fourth edition, Cengage learning, 2012.

2. Computer Forensics – Investigating Network Intrusions & Cyber Crime EC Council Press, 2017, Cengage Learning

Reference Books :

1. Network security essentials, William Stallings, fourth edition, PHI, 2011.

2. Micki Krause, Harold F. Tipton, "Handbook of Information Security Management", Vol 1- 3 CRC Press LLC, 2004.

e-Books :

1. http://faculty.kfupm.edu.sa/COE/marwan/richfiles/misc/Network-security-essentials-4th edition-william-stallings.pdf

2. http://files.gu.edu.ge:8008/.../Principles%20of%20Information%20Security

MOOCS:

1.https://www.mooc-list.com/course/information-security-and-risk-management-context-coursera

2.https://www.coursera.org/learn/cyber-security-domain/lecture/FLyKS/information-security-governance-and-risk-management

Lab Tools Suggested:

Information security:

- Wireshark
- Trace route

Digital Forensics:

- Disk Analysis

Course Title	GREEN COMPUTING				
Course Code	20IS8HSGCG	Credits	2	L-T-P	2-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	2	Total Lecture Hours			24

UNIT – 1	5 Hrs
Green IT Overview: Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green I , Holistic Approach to Greening IT, Greening IT, Applying IT for Enhancing Environmental Sustainability, Green IT Standards and Eco-Labelling of IT, Enterprise Green IT Strategy, Green Washing, Green IT: Burden or Opportunity? Green Devices and Hardware: Introduction , Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose	

UNIT – 2	5 Hrs
Green Software: Introduction, Processor Power States, Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power Sustainable Software Development: Introduction, Current Practices, Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Defining Actions.	

UNIT – 3	4 Hrs
Green Data Centres: Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics.	

UNIT – 4	5 Hrs
Green Networks and Communications: Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards **Enterprise Green IT Strategy:** Introduction, Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Organizational Considerations in a Green IT Strategy, Steps in Developing a Green IT Strategy, Metrics and Measurements in Green Strategies.	

UNIT - 5	5 Hrs
Sustainable Information Systems and Green Metrics: Introduction, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Measuring the Maturity of Sustainable ICT	

Text Books :

1. Harnessing Green IT: Principles and Practices, San Murugesan, G. R. Gangadharan, Wiley & IEEE, 2012.

Reference Books :

1. Green Computing: Tools and Techniques for Saving Energy, Money, and Resources Bud E.Smith CRC Press
2. Green Communications: Principles, Concepts and Practice- Samdanis et al, J. Wiley

e-Books :

1. https://tinyurl.com/yb5tutng
2. http://dsc.soic.indiana.edu/publications/11-greenit-bookch.pdf

MOOCS:

1. http://www.athabascau.ca/syllabi/comp/comp635.php
2. https://www.apus.edu/schedule-classes/schedule/course/issc387

Course Title	BIG DATA ANALYTICS				
Course Code	20IS8OEBDA	Credits	3	L-T-P	3-0-0
CIE	50	SEE	100 Marks (50% Weightage)		
Contact Hours / Week	3	Total Lecture Hours			36

UNIT – 1	7 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	**8 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, Partitioned, Searching, Sorting, compression	
UNIT – 3	**7 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.	
UNIT – 4	**7 Hrs**
Hive – What is Hive?, Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), RCFile Implementation, SerDe, User-defined Function(UDF).	
UNIT - 5	**7 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.	
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. Green Computing: Tools and Techniques for Saving Energy, Money, and Resources Bud E.Smith CRC Press
2. Green Communications: Principles, Concepts and Practice- Samdanis et al, J. Wiley

e-Books :

1. https://tinyurl.com/yb5tutng
2. http://dsc.soic.indiana.edu/publications/11-greenit-bookch.pdf

MOOCS:

1. http://www.athabascau.ca/syllabi/comp/comp635.php
2. https://www.apus.edu/schedule-classes/schedule/course/issc387

Course Title	**WEB TECHNOLOGIES**				
Course Code	**20IS8OEWTS**	**Credits**	**03**	**L-T-P**	**3-0-0**
CIE	**50 Marks**	**SEE**	**100 Marks (50% Weightage)**		
Contact Hours / Week	**3**	**Total Lecture Hours**			**36**
Pre-requisite	**Basic Programming Skills**				

UNIT – 1	**6 Hrs**
HTML5: Document structure, Understanding DOM, HTML Heading Tags, Working with ordered and unordered lists, Image tag, Table and table properties, Form and validations supported by HTML5, anchor tag, block level elements and inline elements, Working with Audio and Video tags.	
UNIT – 2	**7 Hrs**
Cascading Style Sheets: Purpose of CSS, Inline, External and CDN CSS styles representation and formats, Selector forms, Property value forms, Font properties, List properties, Alignment of text, color, The Box model, Flex box, Background images, transitions and animations. **Case Studies: Twitter Bootstrap, Animate.CSS, Google Fonts, Glyph Icons.**	
UNIT – 3	**8 Hrs**
Java Script - I: Program structure in JavaScript: Variables, Conditions, functions, scope and array, objects, classes, pattern matching, Event handling.	
UNIT – 4	**7 Hrs**
Java Script – II: callback functions, arrow functions, JSON, Accessing web services using JSON data, POSTMAN API –HTTP headers and responses codes.	
UNIT - 5	**8 Hrs**
Node JS & Mongo DB : Introduction to Node js, Events, Listeners, Timers, Callbacks, Handling Data I/0, File Access, HTTP Access, Socket Service. **MongoDB**: SQL Vs NoSQL, Accessing DB with Node js, Manipulating, DB data Types, Data Life cycles.	

Text Books :

1. Achyut Godbole, Atul Khathe: Web Technologies 3/e, McGraw Hill Education, 2013.
2. Robert W. Sebesta, Programming the World Wide web, 7th Edition, Pearson Education, 2013.
3. Brad Dayley, Brendan Dayley, Caleb Dayle:, Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications, Pearson Education; Second Edition edition, 2018.

Reference Books :

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, , Internet & World Wide Web How to Program, 5/e , Prentice Hall, , 2013

e-Books :

1. Build your own website the right way using HTML and CSS, 3rd Edition.
2. https://books.goalkicker.com/NodeJSBook/
   https://docs.mongodb.com/manual/tutorial/

MOOCS

1. https://www.mooc-list.com/course/web-development-udacity?static=true
2. https://www.mooc-list.com/course/javascript-basics-udacity?static=true
3. https://www.mooc-list.com/course/intro-html-and-css-udacity?static=true

Course Title	**Seminar Based on Summer/Winter Internship with a Government organization or any other organization or a Premier institute or a Research Lab**				
Course Code	**20IS8SRITR**	**Credits**	**1**	**L-T-P**	**1-0-0**
CIE	**50 Marks**	**SEE**	**50 Marks**		
Contact Hours / Week	**2**				

Technical Seminar is based on:

Summer/Winter Internship with a government organization or any other organization or a premier Institute or a research Lab.

The student should be evaluated for the Summer/Winter Internship done with any company or research lab for two months during the vacation period or during 8th Semester. 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. 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.

Credit Distribution among Curricular Components

UG Scheme from 3rd to 8th Semester
Academic Year of admission 2019-20

Definition of Credit: 1Hr. Lecture (L) per week 1 credit ; 2Hrs Tutorial (T) per week 1 credit ; 2Hrs Practical per week 1 credit

Sem	HS	BS	ES	PC	PE	OE	Proj/Mini Proj	Seminar Technical (SR)	Seminar – Internship (SR)	Non-Credit	Total Credits
I		9	11							A1	**20**
II		9	11							A2	**20**
III	2	4	4	14			2			A3	**26**
IV	1	4		16			2		1	A4	**24**
V	2			15	6		2			A5	**25**
VI	2			12	4	3	2		1	A6	**25**
VII	3	2		1	6	3	3	1		A7	**19**
VIII				2		3	10	1		A8	**16**
Total	**10**	**28**	**26**	**60**	**16**	**9**	**21**	**2**	**2**		**175**

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