DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

PERAMBALUR – 621212

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI
REVISED

DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS

(Applicable to the students admitted from the Academic year 2024 – 2025 and subsequently under Choice Based Credit System)

Discussed in BOS meeting Dated: 24.08.24/ MCA Ratified & Approved in Academic Council on 27.02.25

DHANALAKSHIMI SRINIVASAN ENGINEERING COLLEGE (AUTONOMOUS)
MASTER OF COMPUTER APPLICATIONS
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
I-IV SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	P23MAT12	Applied Probability and Statistics For Computer Science Engineers	FC	4	3	1	0	4
2	P23CAT12	Advanced Data Structures and Algorithms	PC	3	3	0	0	3
3	P23CAT13	Object Oriented Software Engineering	PC	3	3	0	0	3
4	P23CAT14	Python Programming	PC	3	3	0	0	3
5	P23CAT15	Advanced Computer Networks	PC	3	3	0	0	3
6	P23CAT17	Machine Learning	PC	3	3	0	0	3
PRACTICALS								
7	P23CAP11	Advanced Data Structures Laboratory Using C++	PC	4	0	0	4	2
8	P23CAP12	Python programming Laboratory	PC	4	0	0	4	2
9	P23CAP13	Technical Seminar & Report Writing	EEC	2	0	0	2	1
TOTAL				**29**	**18**	**1**	**10**	**24**

SEMESTER II

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	P23CAT21	Advanced Database Technology	PC	4	4	0	0	4
2	P23CAT22	Full Stack Web Development	PC	4	4	0	0	4
3	P23CAT23	Cyber Security	PC	3	3	0	0	3
4	P23CAT24	Big Data Analytics	PC	3	3	0	0	3
5		Professional Elective – I	PE	3	3	0	0	3
6		Professional Elective – II	PE	3	3	0	0	3
PRACTICALS								
7	P23CAP21	Advanced Database Technology Laboratory	PC	4	0	0	4	2
8	P23CAP22	Full Stack Web Development Laboratory	PC	4	0	0	4	2
TOTAL				**28**	**20**	**0**	**8**	**24**

SEMESTER III

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	P23CAT32	Industry 4.0	PC	3	3	0	0	3
2	P23CAT33	Research Methodology and IPR	RMC	2	2	0	0	2
3	P23CAT34	Data Science & Analytics	PC	4	4	0	0	4
4		Professional Elective III	PE	3	3	0	0	3
5		Professional Elective IV	PE	3	3	0	0	3
6		Open Elective	OE	3	3	0	0	3
PRACTICALS								
7	P23CAP28	Cloud computing Laboratory	PC	4	0	0	4	2
8	P23CAP29	Data Science Laboratory	PC	4	0	0	4	2
9	P23CAP31	Project work – Phase I	EEC	4	0	0	4	2
			TOTAL	**30**	**18**	**0**	**12**	**25**

SEMESTER IV

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	P23CAP32	Project Work – Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO.OF CREDITS : 85

TOTAL COURSES & CREDITS – SEMESTER WISE

SEMESTER	I	II	III	IV	Total
NO OF COURSES	9	8	9	1	**27**
CREDITS	24	24	25	12	**85**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 85

SUMMARY

S. NO	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1	Foundation Courses (FC)	04	00	00	00	04
2	Professional Core Courses (PC)	19	18	12	00	49
3	Employability Enhancement Courses (EEC)	01	00	02	12	15
4	Professional Electives (PE)		06	06	00	12
5	Open Elective (OE)			03	00	03
5	Research Methodology Courses (RMC)			02	00	02
TOTAL		**24**	**24**	**25**	**12**	**85**

FOUNDATION COURSES (FC)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23MAT12	Applied Probability and Statistics For Computer Science Engineers	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAT12	Advanced Data Structures and Algorithms	PC	3	3	0	0	3
2	P23CAT13	Object Oriented Software Engineering	PC	3	3	0	0	3
3	P23CAT14	Python Programming	PC	3	3	0	0	3
4	P23CAT15	Advanced Computer Networks	PC	3	3	0	0	3
5	P23CAT17	Machine Learning	PC	3	3	0	0	3
6	P23CAP11	Advanced Data Structures Laboratory Using C++	PC	4	0	0	4	2
7	P23CAP12	Python programming Laboratory	PC	4	0	0	4	2
8	P23CAT21	Advanced Database Technology	PC	4	4	0	0	4
9	P23CAT22	Full Stack Web Development	PC	3	3	0	0	3
10	P23CAT23	Cyber Security	PC	4	4	0	0	4
11	P23CAT24	Big Data Analytics	PC	3	3	0	0	3
12	P23CAP21	Advanced Database Technology Laboratory	PC	4	0	0	4	2
13	P23CAP22	Full Stack Web Development Laboratory	PC	4	0	0	4	2
14	P23CAT32	Industry 4.0	PC	3	3	1	0	4
15	P23CAT34	Data Science & Analytics	PC	4	4	0	0	4
16	P23CAP28	Cloud computing Laboratory	PC	4	0	0	4	2
17	P23CAP29	Data Science Laboratory	PC	4	0	0	4	2

Research Methodology and IPR COURSES (RMC)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAT33	Research Methodology and IPR	RMC	2	0	0	2	2

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAP13	Technical Seminar & Report Writing	EEC	4	0	0	4	2
2		Project Work – Phase I	EEC	4	0	0	4	2
3		Project Work – Phase II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVE – I SEMESTER II

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23MAE11	Operations Research	PE	3	3	0	0	3
2	P23CAE13	Software Testing	PE	3	3	0	0	3
3	P23CAE16	Advanced Operating System	PE	3	3	0	0	3
4	P23CAE17	E-Learning	PE	3	3	0	0	3
5	P23CAE18	Business Data Analytics	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II SEMESTER II

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAE21	Embedded Systems	PE	3	3	0	0	3
2	P23CAE22	Artificial Intelligence	PE	3	3	0	0	3
3	P23CAE23	Soft computing	PE	3	3	0	0	3
4	P23CAE24	Social Network Analysis	PE	3	3	0	0	3
5	P23CAE25	Digital Image Processing	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III SEMESTER III

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAE33	DevOps and Micro services	PE	3	3	0	0	3
2	P23CAE34	Cyber Forensics	PE	3	3	0	0	3
3	P23CAE35	Bio Inspired Learning	PE	3	3	0	0	3
4	P23CAE36	Deep Learning	PE	3	3	0	0	3
5	P23CAE37	Advances in Networking	PE	3	3	0	0	3

PROFESSIONAL
ELECTIVE – IV
SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAE41	Information Retrieval Techniques	PE	3	3	0	0	3
2	P23CAE42	Digital Marketing	PE	3	3	0	0	3
3	P23CAE43	Data visualization and Techniques	PE	3	3	0	0	3
4	P23CAE44	Bio-informatics	PE	3	3	0	0	3
5	P23CAE45	Adhoc and Sensor Network	PE	3	3	0	0	3

Mandatory	
Internship I	II SEMESTER VACATION
List of Mandatory Courses (No Credits & End Exam – Only Internal Evaluation)	
Corporate Communication Skills	II SEMESTER
Personality Development and Soft Skills	III SEMESTER

OPEN ELECTIVE
SEMESTER III

SI. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAO1	Integrated Water Resources Management	OE	3	3	0	0	3
2	P23CAO2	Water, Sanitation and Health	OE	3	3	0	0	3
3	P23CAO3	Principles of Sustainable Development	OE	3	3	0	0	3
4	P23CAO4	Environmental Impact Assessment in Domestic sectors	OE	3	3	0	0	3
5	P23CAO5	Vibration and Noise Control Strategies	OE	3	3	0	0	3
6	P23CAO6	Energy Conservation and Management in domestic sectors	OE	3	3	0	0	3
7	P23CAO7	Additive Manufacturing	OE	3	3	0	0	3
8	P23CAO8	Electric Vehicle Technology	OE	3	3	0	0	3
9	P23CAO9	New Product Development	OE	3	3	0	0	3
10	P23CAO10	Sustainable Management	OE	3	3	0	0	3
11	P23CAO11	Micro and Small Business Management	OE	3	3	0	0	3
12	P23CAO12	Intellectual Property Rights	OE	3	3	0	0	3
13	P23CAO13	Ethical Management	OE	3	3	0	0	3
14	P23CAO14	IOT for Smart Systems	OE	3	3	0	0	3
15	P23CAO15	Machine Learning and Deep Learning	OE	3	3	0	0	3
16	P23CAO16	Renewable Energy Technology	OE	3	3	0	0	3
17	P23CAO17	Smart Grid	OE	3	3	0	0	3
18	P23CAO18	Big Data Analytics	OE	3	3	0	0	3
19	P23CAO19	Internet of Things and Cloud	OE	3	3	0	0	3
20	P23CAO20	Medical Robotics	OE	3	3	0	0	3
21	P23CAO21	Embedded Automation	OE	3	3	0	0	3
22	P23CAO22	Environmental Sustainability	OE	3	3	0	0	3
23	P23CAO23	Textile Reinforced Composites	OE	3	3	0	0	3
24	P23CAO24	Nanocomposite Materials	OE	3	3	0	0	3
25	P23CAO25	IPR, Biosafety and Entrepreneurship	OE	3	3	0	0	3
26	P23CAO26	Block Chain Technologies	OE	3	3	0	0	3
27	P23CAO27	Professional Ethics in IT	OE	3	3	0	0	3

SEMESTER I

P23MAT12	APPLIED PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE ENGINEERS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1.	To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
2.	To enable students to understand the concepts of Probability and Random Variables.
3.	To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the central limit theorem.
4.	To apply the small /large sample tests through Tests of hypothesis.
5.	To enable the students to use the concepts of multivariate normal distribution and principal components analysis.

UNIT I	**LINEAR ALGEBRA**	**12**

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization – generalized eigenvectors – Canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

UNIT II	**PROBABILITY AND RANDOM VARIABLES**	**12**

Probability – Axioms of probability – Conditional probability – Bayes' theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT III	**TWO DIMENSIONAL RANDOM VARIABLES**	**12**

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT IV	**TESTING OF HYPOTHESIS**	**12**

Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t , Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V	**MULTIVARIATE ANALYSIS**	**12**

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Populations principal components – Principal components from standardized variables.

TOTAL:60 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply the concepts of Linear Algebra to solve practical problems.
CO2:	Use the ideas of probability and random variables in solving engineering problems.
CO3:	Be familiar with some of the commonly encountered two dimension random Variables and be

	equipped for a possible extension to multivariate analysis.
CO4:	Use statistical tests in testing hypothesis on data
CO5:	Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.
CO6:	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
REFERENCES BOOKS :	
1	Richard A. Johnson and Dean W. Wichern, "Applied multivariate statistical Analysis", Pearson Education , Fifth Edition, 6th Edition, New Delhi, 2013.
2	Bronson, R., "Matrix Operation" Schaum's outline series, Tata McGraw Hill ,New York, 2011.
3	T.K..V Iyengar& B.Krishna Gandhi S.Ranganatham,MVSSAN Prasad. "Probability and Statistics" , S Chand Publishers.
4	Johnson R. A. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers" ,Pearson India Education, Asia, 9th Edition , New Delhi, 2017

P23CAT12	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	To understand the usage of algorithms in computing
2	To learn and use hierarchical data structures and its operations
3	To learn the usage of graphs and its applications
4	To select and design data structures and algorithms that is appropriate for problems
5	To study about NP Completeness of problems.

UNIT I	ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS	9

Algorithms – Algorithms as a Technology –Time and Space complexity of algorithms– Asymptotic analysis–Average and worst–case analysis–Asymptotic notation–Importance of efficient algorithms–Program performance measurement – Recurrences: The Substitution Method – The Recursion– Tree Method– Data structures and algorithms.

UNIT II	HIERARCHICAL DATA STRUCTURES	9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion– Red Black trees: Properties of Red–Black Trees – Rotations – Insertion – Deletion –B–Trees: Definition of B – trees – Basic operations on B–Trees – Deleting a key from a B–Tree– Heap – Heap Implementation – Disjoint Sets – Fibonacci Heaps: structure – Merge able–heap operations– Decreasing a key and deleting a node–Bounding the maximum degree.

UNIT III	GRAPHS	9

Elementary Graph Algorithms: Representations of Graphs – Breadth–First Search – Depth–First Search – Topological Sort – Strongly Connected Components– Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim– Single–Source Shortest Paths: The Bellman–Ford algorithm – Single–Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm; Dynamic Programming – All–Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd–War shall Algorithm.

UNIT IV	ALGORITHM DESIGN TECHNIQUES	9

Dynamic Programming: Matrix–Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence– Greedy Algorithms: – Elements of the Greedy Strategy– An Activity–Selection Problem – Huffman Coding.

UNIT V	NP COMPLETE AND NP HARD	9

NP–Completeness: Polynomial Time – Polynomial–Time Verification – NP– Completeness and Reducibility – NP–Completeness Proofs – NP–Complete Problems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Design data structures and algorithms to solve computing problems.
CO2	Choose and implement efficient data structures and apply them to solve problems.
CO3	Design algorithms using graph structure and various string–matching algorithms to solve real–life problems
CO4	Design one’s own algorithm for an unknown problem.

CO5	Apply suitable design strategy for problem solving.
CO6	Apply Data Structures and Algorithms in C++.

TEXT BOOKS:	
1	E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms",University Press, 2nd Edition, 2008.
2	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms".

REFERENCE BOOKS:	
1	S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014
2	Adam Drozdex, "Data Structures and Algorithms in C++", Cengage Learning, 4th Edition, 2013
3	T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012
4	Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009.

P23CAT13	OBJECT ORIENTED SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the phases in object oriented software development
2	To gain fundamental concepts of requirements engineering and analysis.
3	To know about the different approach for object oriented design and its methods
4	To learn about how to perform object oriented testing and how to maintain software
5.	To provide various quality metrics and to ensure risk management

UNIT I	SOFTWARE DEVELOPMENT AND PROCESS MODELS	9

Introduction to Software Development – Challenges – An Engineering Perspective – Object Orientation – Software Development Process – Iterative Development Process – Process Models– Life Cycle Models – Unified Process – Iterative and Incremental – Agile Processes.

UNIT II	MODELING OO SYSTEMS	9

Object Oriented Analysis (OOA / Coad–Yourdon), Object Oriented Design (OOD/Brooch), Hierarchical Object Oriented Design (HOOD), Object Modeling Technique (OMT) – Requirement Elicitation – Use Cases – SRS Document – OOA – Identification of Classes and Relationships, Identifying State and Behavior – OOD – Interaction Diagrams – Sequence Diagram – Collaboration Diagrams – Unified Modeling Language and Tools.

UNIT III	DESIGN PATTERNS	9

Design Principles – Design Patterns – GRASP – GoF – Dynamic Object Modeling – Static Object Modeling.

UNIT IV	SYSTEM TESTING	9

Software testing: Software Verification Techniques – Object Oriented Checklist: – Functional Testing – Structural Testing – Class Testing – Mutation Testing – Levels of Testing – Static and Dynamic Testing Tools – Software Maintenance – Categories – Challenges of Software Maintenance – Maintenance of Object Oriented Software – Regression Testing.

UNIT V	SOFTWARE QUALITY AND METRICS	9

Need of Object Oriented Software Estimation – Lorenz and Kidd Estimation – Use Case Points Method – Class Point Method – Object Oriented Function Point – Risk Management – Software Quality Models – Analyzing the Metric Data – Metrics for Measuring Size and Structure – Measuring Software Quality – Object Oriented Metrics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Design object oriented software using appropriate process models.
CO2	Differentiate software processes under waterfall and agile methodology.
CO3	Design and Develop UML diagrams for software projects.
CO4	Apply Design Patterns for a software process.
CO5	Categorize testing methods and compare different testing tools for software processes.
CO6	Analyze object oriented metrics and quality for software engineering processes.

TEXT BOOKS:

1	Roger S. Pressman, "Software Engineering: A Practitioner's Approach, Tata McGraw-Hill

	Education, 8th Edition, 2015.\
2	Design and Iterative Development", Pearson Education, Third Edition, 2008.
REFERENCE BOOKS:	
1	Yogesh Singh, RuchikaMalhotra, " Object – Oriented Software Engineering", PHI Learning Private Limited ,First edition,2012
2	Ivar Jacobson. Magnus Christerson, PatrikJonsson, Gunnar Overgaard, "Object Oriented Software Engineering, A Use Case Driven Approach", Pearson Education, Seventh Impression, 2009
3	Craig Larman, "Applying UML and Patterns, an Introduction to Object–Oriented Analysis and Design and Iterative Development", Pearson Education, Third Edition, 2008.
4	Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen

P23CAT14	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To develop Python programs with conditionals, loops and functions.
2	To use Python data structures – lists, tuples, dictionaries.
3	To do input/output with files in Python
4	To use modules, packages and frameworks in python\
5	To define a class with attributes and methods in python

UNIT I	BASICS OF PYTHON	9

Introduction to Python Programming – Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements. Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If–Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement–Continue statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

UNIT II	DATA TYPES IN PYTHON	9

Lists, Tuples, Sets, Strings, Dictionary, Modules: Module Loading and Execution – Packages – Making Your Own Module – The Python Standard Libraries.

UNIT III	FILE HANDLING AND EXCEPTION HANDLING	8

Files: Introduction – File Path – Opening and Closing Files – Reading and Writing Files –File Position –Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

UNIT IV	MODULES, PACKAGES AND FRAMEWORKS	10

Modules: Introduction – Module Loading and Execution – Packages – Making Your Own Module – The Python Libraries for data processing, data mining and visualization– NUMPY, Pandas, Matplotlib, Plotly–Frameworks– –Django, Flask, Web2Py.

UNIT V	OBJECT ORIENTED PROGRAMMING IN PYTHON	9

Creating a Class, Class methods, Class Inheritance, Encapsulation, Polymorphism, class methods. static methods, Python object persistence.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Represent compound data using Python lists, tuples and dictionaries.
CO3	Read and write data from/to files in Python Programs
CO4	Structure simple Python programs using libraries, modules etc.
CO5	Structure a program by bundling related properties and behaviors into individual objects.
CO6	Apply Python Programming using Problem Solving Approach.

TEXT BOOKS:

1	Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition First Edition, 2016.

2	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist" 2016.
REFERENCE BOOKS:	
1	Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, First edition, 2017.
2	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff, O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/
3	Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised and Updated for Python 32, Network Theory Ltd., First edition, 2011
4	John V Guttag, "Introduction to Computation and Programming Using Python", Revised and Expanded Edition, MIT Press, 2013

P23CAT15	ADVANCED COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	This course focuses on advanced networking concepts for next generation network architecture and design
2	It covers SDN and virtualization for designing next generation networks
3	Its focus on implementation connection oriented services.
4	To do Border Gateway Protocol V4
5	To do connectionless versus connection oriented protocols.

UNIT I	NETWORK LAYER	9

Network layer: Network Layer Services, Packet Switching, Performance, provided transport layers, implementation connectionless services, implementation connection oriented services, comparison of virtual –circuit and datagram subnets.IPV4 Address, Forwarding of IP Packets, Internet Protocol, ICMP v4, Mobile IP.

UNIT II	ROUTING ALGORITHMS	9

Routing Algorithms–Distance Vector routing, Link State Routing, Path Vector Routing, Unicast Routing Protocol–Internet Structure, Routing Information Protocol, Open Source Path First, Border Gateway Protocol V4, Broadcast routing, Multicasting routing, Multicasting Basics, Intra domain Multicast Protocols, IGMP.

UNIT III	TRANSPORT LAYER	9

IPv6 Addressing, IPv6 Protocol, Transition from IPv4 to IPv6.Transport Layer Services, connectionless versus connection oriented protocols. Transport Layer Protocols: Simple Protocol, Stop and Wal, Go–Back–N, Selective repeat, Piggy Backing. UDP: User datagram, Services, Applications. TCP: TCP services, TCP features, segment, A TCP connection, Flow control, error control, congestion control.

UNIT IV	INTERNET LAYER	9

SCTP: SCTP services SCTP features, packet format, An SCTP association, flow control, error control .QUALITY OF SERVICE: flow characteristics, flow control to improve QOS: scheduling, traffic shaping, resource reservation, admission control.

UNIT V	APPLICATION LAYER	9

WWW and HTTP, FTP, Telnet, Domain name system, SNMP, Multimedia data, Multimedia in the Internet.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Understand advanced concepts and next generation networks
CO2	Analyze TCP/IP variants, network Algorithm's, Protocols and their functionalities
CO3	Comprehend features of SDN and its application to next generation systems
CO4	Analyze the performance of various server implementation
CO5	Analyze the concepts involved in the application layer.
CO6	Analyze the connectionless versus connection oriented protocols.

TEXT BOOKS:

1	Marschke D, Doyle J, Moyer P. Software Defined Networking (SDN): Anatomy of OpenFlow Volume 1 2015.
2	Software Defined Networks: a Comprehensive Approach. Morgan Kaufmann; 2014
REFERENCE BOOKS:	
1	Stallings W. Data and Computer Communications. Pearson Education India; 2006.
2	Douglas E Comer. Internet Working with TCP/IP Volume –1, Sixth Edition, Addison–Wesley Professional;2013
3	Goransson P, Black C, Culver T. Software Defined Networks: a Comprehensive Approach. Morgan Kaufmann; 2014
4	Chayapathi R, Hassan SF, Shah P. Network Functions Virtualization (NFV) with a Touch of SDN: Netw Fun Vir (NFV ePub_1 Addison–Wesley Professional; 2016 Nov 14

P23CAT17	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the basic concepts of machine learning.
2	To understand and build supervised learning models.
3	To understand and build unsupervised learning models.
4	To evaluate the algorithms based on corresponding metrics identified
5	To understand the working of Machine learning platform.

UNIT I	INTRODUCTION TO MACHINE LEARNING	9

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT II	SUPERVISED LEARNING	9

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

UNIT III	ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING	8

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT IV	NEURAL NETWORKS	10

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout

UNIT V	DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS	9

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Explain the basic concepts of machine learning.
CO2	Construct supervised learning models.
CO3	Construct unsupervised learning algorithms.
CO4	Evaluate and compare different models
CO5	Use smart contract for real world application in a machine learning platforms.
CO6	Use prediction markets and real world data feeds.

TEXT BOOKS:

1	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2	Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014

REFERENCE BOOKS:	
1	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997
3	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018.

P23CAP11	ADVANCED DATA STRUCTURES LABORATORY USING C++	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES	
The main learning objective of this course is to prepare the students for:	
1	To acquire the knowledge of using advanced tree structures
2	To learn the usage of heap structures
3	To understand the usage of graph structures and spanning trees
4	To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
5	To understand the necessary mathematical abstraction to solve problems.

LIST OF EXPERIMENTS	
1	Implementation of recursive function for tree traversal and Fibonacci
2	Implementation of iteration function for tree traversal and Fibonacci
3	Implementation of Merge Sort and Quick Sort
4	Implementation of a Binary Search Tree
5	Red–Black Tree Implementation
6	Heap Implementation
7	Fibonacci Heap Implementation
8	Graph Traversals
9	Spanning Tree Implementation
10	Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11	Implementation of Matrix Chain Multiplication
12	Activity Selection and Huffman Coding Implementation
	TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

SI No	Name of the Equipment	Quantity
1	64–bit Open source Linux or its derivative	
2	Open Source C++ Programming tool like G++/GCC	

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Design and implement basic and advanced data structures extensively
CO2	Design algorithms using graph structures
CO3	Design and develop efficient algorithms with minimum complexity using design techniques
CO4	Develop programs using various algorithms.
CO5	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem
CO6	Implementation of iteration function for tree traversal and Fibonacci.

P23CAP12	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	Develop Python programs with conditionals, loops and functions.
2	Represent compound data using Python lists, tuples, dictionaries.
3	Read and write data from/to files in Python.
4	Implement NumPy, Pandas, Matplotlib libraries.
5	Implement object oriented concepts.

LIST OF EXPERIMENTS

1	Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
2	Scientific problems using Conditionals and Iterative loops.
3	Linear search and Binary search
4	Selection sort, Insertion sort
5.	Merge sort, Quick Sort
6.	Implementing applications using Lists, Tuples.
7.	Implementing applications using Sets, Dictionaries.
8.	Implementing programs using Functions.
9.	Implementing programs using Strings
10.	Implementing programs using written modules and Python Standard Libraries (pandas, numpy,Matplotlib, scipy)
11	Implementing real–time/technical applications using File handling.
12	Implementing real–time/technical applications using Exception handling.
13	Creating and Instantiating classes

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1	64–bit Open source Linux or its derivative	
2	Open Source C++ Programming tool like G++/GCC	

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Design and implement basic and advanced data structures extensively
CO2	Design algorithms using graph structures
CO3	Design and develop efficient algorithms with minimum complexity using design techniques
CO4	Develop programs using various algorithms.
CO5	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem
CO6	Implementing programs using Strings

P23CAP13	TECHNICAL SEMINAR AND REPORT WRITING	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES	
The main learning objective of this course is to prepare the students for:	
1	To provide opportunities to learners to practice English and thereby make them proficient users of the language.
2	To enable learners to fine–tune their linguistic skills (LSRW) with the help of technology.
3	To improve the performance of students' listening, speaking, reading and writing skills andthereby enhance their career opportunities.

LIST OF ACTIVITIES	
1	Listening: Listening and practicing neutral accents Listening to short talks and lectures and completing listening comprehension exercises Listening to TED Talks
2	Speaking: Giving one minute talks Participating in small Group Discussions Making Presentations
3	Reading: Reading Comprehension Reading subject specific material Technical Vocabulary
4	Writing: Formal vs Informal Writing Paragraph Writing Essay Writing Email Writing
5	Practice Session
6	Resume / Report Preparation / Letter writing: Students prepare their own resume and report.
7	Presentation Skills: Students make presentations on given topics.
8	Group Discussion: Students participate in group discussions.
9	Interview Skills: Students participate in Mock Interviews
	TOTAL: 30 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Listen and comprehend lectures in English
CO2	Articulate well and give presentations clearly
CO3	Participate in Group Discussions successfully
CO4	Communicate effectively in formal and informal writing
CO5	Write proficient essays and emails
CO6	completing listening comprehension exercises Listening to TED Talks.

SEMESTER II

P23CAT21	ADVANCED DATABASE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the working principles and query processing of distributed databases.
2	To understand the working principles and query processing of distributed databases.
3	To distinguish the different types of NoSQL databases
4	To understand the basics of XML and create well–formed and valid XML documents.
5	To gain knowledge about information retrieval and web search

UNIT I	DISTRIBUTED DATABASES	9

Distributed Systems – Introduction – Architecture – Distributed Database Concepts – Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing

UNIT II	SPATIAL AND TEMPORAL DATABASES	9

Active Databases Model – Design and Implementation Issues – Temporal Databases – Temporal Querying – Spatial Databases: Spatial Data Types, Spatial Operators and Queries – Spatial Indexing and Mining – Applications — Mobile Databases: Location and Handoff Management, Mobile Transaction Models – Deductive Databases – Multimedia Databases

UNIT III	NOSQL DATABASES	9

NoSQL – CAP Theorem – Sharding – Document based – MongoDB Operation: Insert, Update, Delete, Query, Indexing, Application, Replication, Sharding–Cassandra: Data Model, Key Space, Table Operations, CRUD Operations, CQL Types – HIVE: Data types, Database Operations, Partitioning – HiveQL – OrientDB Graph database – OrientDB Features.

UNIT IV	XML DATABASES	9

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery.

UNIT V	INFORMATION RETRIEVAL AND WEB SEARCH	9

IR concepts – Retrieval Models – Queries in IR system – Text Pre-processing – Inverted Indexing – Evaluation Measures – Web Search and Analytics – Current trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Design a distributed database system and execute distributed queries.
CO2	Manage Spatial and Temporal Database systems and implement it in corresponding applications.
CO3	Use NoSQL database systems and manipulate the data associated with it.
CO4	Design XML database systems and validate with XML schema.
CO5	Apply knowledge of information retrieval concepts on web databases.
CO6	Apply Database Operations, Partitioning.

TEXT BOOKS:	
1	Brad Dayley, "Teach Yourself NoSQL with MongoDB in 24 Hours", Sams Publishing, First Edition, 2014
2	C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
REFERENCE BOOKS:	
1	Abraham Silberschatz, Henry F Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2019.
2	R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education/Addison Wesley, 2017.
3	Guy Harrison, "Next Generation Databases, NoSQL, NewSQL and Big Data", First Edition,Apress publishers, 2015
4	Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", ThirdEdition, Morgan Kaufmann, 2012

P23CAT22	FULL STACK WEB DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	Understand the core concepts of web development and how the front-end and back-end interact.
2	Build interactive user interfaces using HTML, CSS, JavaScript, and front-end frameworks such as React or Angular.
3	Integrate and manage databases using SQL (e.g., MySQL, PostgreSQL) and NoSQL (e.g., MongoDB) databases.
4	Implement RESTful APIs and connect them with front-end applications.
5	To do Working with Text and Images with CSS.

UNIT I	INTRODUCTION TO CSS and JAVASCRIPT	9

Introduction to Web: Server – Client – Communication Protocol (HTTP) – Structure of HTML Documents – Basic Markup tags – Working with Text and Images with CSS– CSS Selectors – CSS Flexbox – JavaScript: Data Types and Variables – Functions – Events – AJAX: GET and POST

UNIT II	SERVER SIDE PROGRAMMING WITH NODE JS	9

Introduction to Web Servers – JavaScript in the Desktop with Nodesjs – NPM – Serving files with the http module – Introduction to the Express framework – Server–side rendering with Templating Engines – Static Files – async/await – Fetching JSON from Express.

UNIT III	ADVANCED NODE JS AND DATABASE	9

Introduction to NoSQL databases – MongoDB system overview – Basic querying with MongoDB shell – Request body parsing in Express – NodeJS MongoDB connection – Adding and retrieving data to MongoDB from NodeJS – Handling SQL databases from NodeJS – Handling Cookies in NodeJS – Handling User Authentication with NodeJS

UNIT IV	ADVANCED CLIENT SIDE PROGRAMMING	9

React JS: React DOM – JSX – Components – Properties – Fetch API – State and Lifecycle – –JS Local storage – Events – Lifting State Up – Composition and Inheritance

UNIT V	APP IMPLEMENTATION IN CLOUD	9

Cloud providers Overview – Virtual Private Cloud – Scaling (Horizontal and Vertical) – Virtual Machines, Ethernet and Switches – Docker Container – Kubernetes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Write client side scripting HTML, CSS and JS.
CO2	Implement and architect the server side of the web application.
CO3	Implement Web Application using NodeJS.
CO4	Architect NoSQL databases with MongoDB.
CO5	Implement a full–stack Single Page Application using React, NodeJS and MongoDB and deploy on Cloud.
CO6	Implementing side rendering with Templating Engines.

TEXT BOOKS:	
1	Joe Beda, Kelsey Hightower, Brendan Burns, “Kubernetes: Up and Running”, O’Reilly Media, 1st edition, 2017.
2	Paul Zikopoulos, Christopher Bienko, Chris Backer, Chris Konarski, Sai Vennam, “Cloud Without Compromise”, O’Reilly Media, 1st edition, 2021
REFERENCE BOOKS:	
1	David Flanagan, “Java Script: The Definitive Guide”, O’Reilly Media, Inc, 7th Edition, 2020
2	Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN: 978–1–119–36656–0, 2019
3	Alex Banks, Eve Porcello, "Learning React", O’Reilly Media, Inc, 2nd Edition, 2020
4	Marc Wandschneider, “Learning Node”, Addison–Wesley Professional, 2nd Edition, 2016

P23CAT23	CYBER SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To learn the principles of cyber security and to identify threats and risks.
2	To learn how to secure physical assets and develop system security controls.
3	To understand how to apply security for Business applications and Network Communications.
4	To learn the technical means to achieve security.
5	To learn to monitor and audit security measures.

UNIT I	PLANNING FOR CYBER SECURITY	9

Best Practices–Standards and a plan of Action–Security Governance Principles, components and Approach–Information Risk Management–Asset Identification–Threat Identification–Vulnerability Identification–Risk Assessment Approaches–Likelihood and Impact Assessment–Risk Determination, Evaluation and Treatment–Security Management Function–Security Policy–
Acceptable Use Policy– Security Management Best Practices – Security Models: Bell La Padula model, Biba Integrity Model – Chinese Wall model

UNIT II	SECURITY CONTROLS	9

People Management–Human Resource Security–Security Awareness and Education–Information Management– Information Classification and handling–Privacy–Documents and Record Management–Physical Asset Management–Office Equipment–Industrial Control Systems–Mobile Device Security–
System Development–Incorporating Security into SDLC – Disaster management and Incident response planning.

UNIT III	CYBER SECURITY FOR BUSINESS APPLICATIONS ANDNETWORKS	9

Business Application Management–Corporate Business Application Security–End user Developed Applications–System Access– Authentication Mechanisms–Access Control–System Management–Virtual Servers–Network Storage Systems–Network Management Concepts–Firewall–IP Security–Electronic Communications – Case study on OWASP vulnerabilities using OWASP ZAP tool.

UNIT IV	TECHNICAL SECURITY	9

Supply Chain Management–Cloud Security–Security Architecture–Malware Protection–Intrusion Detection–Digital Rights Management–Cryptographic Techniques–Threat and Incident Management– Vulnerability Management–Security Event Management–Forensic Investigations–
Local Environment Management–Business Continuity.

UNIT V	SECURITY ASSESSMENT	9

Security Monitoring and Improvement–Security Audit–Security Performance–
Information RiskReporting–Information Security Compliance Monitoring–Security Monitoring and Improvement Best Practices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Develop a set of risk and security requirements to ensure that there are no gaps in an organization's security practices.
CO2	Achieve management, operational and technical means for effective cyber security.
CO3	Audit and monitor the performance of cyber security controls.
CO4	Spot gaps in the system and devise improvements.

CO5	Identify and report vulnerabilities in the system
CO6	Use Information Security Compliance Monitoring
TEXT BOOKS:	
1	Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", 2nd Edition, Syngress, 2013
2	Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, 2015.
REFERENCE BOOKS:	
1	William Stallings, "Effective Cyber Security – A guide to using Best Practices and Standards",Addison–Wesley Professional, First Edition, 2019.
2	Adam Shostack, "Threat Modelling – Designing for Security", Wiley Publications, First Edition,2014
3	Gregory J. Touhill and C. Joseph Touhill, "Cyber Security for Executives – A Practical Guide",Wiley Publications, First Edition, 2014
4	Raef Meeuwisse, "Cyber Security for Beginners", Second Edition, Cyber Simplicity Ltd, 2017.

P23CAT24	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To explore the fundamental concepts of big data analytics
2	To learn to analyze the big data using intelligent techniques.
3	To understand the various search methods and visualization techniques.
4	To learn to use various techniques for mining data stream.
5	Importance and challenges facing big data.

UNIT I	INTRODUCTION TO BIG DATA	9

Introduction to Big data: Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, Traditional Business Intelligence (BI) versus Big Data. Big data analytics: Classification of Analytics, Importance and challenges facing big data, Terminologies Used in Big Data Environments, The Big Data Technology Landscape.

UNIT II	INTRODUCTION TO HADOOP	9

Introducing Hadoop, RDBMS versus Hadoop, Distributed Computing Challenges, History and overview of Hadoop, Use Case of Hadoop, Hadoop Distributors, Processing Data with Hadoop, Interacting with Hadoop Ecosystem

UNIT III	THE HADOOP DISTRIBUTED FILESYSTEM	9

Hadoop Distributed File System(HDFS):The Design of HDFS, HDFS Concepts, Basic File system Operations, Hadoop File systems. The Java Interface– Reading Data from a Hadoop URL, Reading Data Using the File system API, Writing Data. Data Flow– Anatomy of a File Read, Anatomy of a File Write, Limitations.

UNIT IV	UNDERSTANDING MAP REDUCE FUNDAMENTALS	9

Map Reduce Framework: Exploring the features of Map Reduce, Working of Map Reduce, Exploring Map and Reduce Functions, Techniques to optimize Map Reduce jobs, Uses of Map Reduce. Controlling Map Reduce Execution with Input Format, Reading Data with custom Record Reader,–Reader, Writer, Combiner, Practitioners, Map Reduce Phases, Developing simple Map Reduce Application.

UNIT V	INTRODUCTION TO PIG and HIVE	9

Introducing Pig: Pig architecture, Benefits, Installing Pig, Properties of Pig, Running Pig, Getting started with Pig Latin, Working with operators in Pig, Working with functions in Pig. Introducing Hive: Getting started with Hive, Hive Services, Data types in Hive, Built–in functions in Hive, Hive DDL.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Understand what Big Data, importance and various sources of data.
CO2	Describe the elements of big data–volume, variety, velocity and veracity.
CO3	Define distributed and parallel computing for big data.
CO4	Understand Map Reduce and its qualities and retain advanced Map Reduce thoughts.
CO5	Design and implement different technologies for processing big data in pig and hive.

CO6	Use Built–in functions.
TEXT BOOKS:	
1	Rajiv Sabherwal, Irma Becerra- Fernandez, ―Business Intelligence –Practice, Technologies and Management, John Wiley, 1st Edition, 2011
2	Arvind Sathi, ―Big Data Analytics: Disruptive Technologies for Changing the Game, IBM Corporation, 1st Edition, 2012
REFERENCE BOOKS:	
1	Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley Publications, 2nd Edition,2014DT Editorial Services, ―Big Data, Dream Tech Press, 2ndEdition, 2015.
2	Tom White, ―Hadoop: The Definitive Guide, O'Reilly, 3 rd Edition, 2012
3	Black Book Big Data, dreamtech publications , 1st Edition, 2017.
4	Michael Minelli, Michele Chambers, Ambiga Dhiraj, ―Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Wiley CIO Series, 1st Edition, 2013

P23MAE11	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	This module aims to introduce students to use quantitive methods
2	Techniques for effective decisions
3	Model formulation and applications that are used in solving
4	Business decision problems.
5	Basics definition, scope, objectives, phases

UNIT I	INTRODUCTION TO OPERATIONS RESEARCH	9

Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem – Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M method, two-phase method, degeneracy and unbound solutions.

UNIT II	TRANSPORTATION PROBLEM	9

Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.

UNIT III	ASSIGNMENT MODEL	9

Formulation. Hungarian method for optimal solution. Solving unbalanced problem. Traveling salesman problem and assignment problem.

UNIT IV	SEQUENCING MODELS	9

Solution of Sequencing Problem – Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

UNIT V	DYNAMIC PROGRAMMING	9

Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Dynamic programming approach for Priority
CO2	Management employment smoothening
CO3	the stepping stone method and MODI method.
CO4	unbalanced Transportation problem
CO5	cargo loading and Reliability problems.
CO6	degeneracy and unbound solutions.

TEXT BOOKS:

1	P. Sankara Iyer, "Operations Research", Tata McGraw-Hill, 2008.
2	A.M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education, 2005.

REFERENCE BOOKS:	
1	J K Sharma., "Operations Research Theory & Applications , 3e", Macmillan India Ltd, 2007.
2	P. K. Gupta and D. S. Hira, "Operations Research", S. Chand & co., 2007.
3	J K Sharma., "Operations Research, Problems and Solutions, 3e", Macmillan India Ltd.
4	N.V.S. Raju, "Operations Research", HI-TECH, 2002.

P23CAE13	SOFTWARE TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	Provides principles of Software Testing and tools.
2	Enable the students to learn about the principle and tools of Software testing.
3	Improve knowledge in software testing tools.
4	To do Playing pool and consulting oracles
5	Implementation and Application of Path Testing

UNIT I	SOFTWARE TESTING	9

Purpose of Software testing – Some Dichotomies – a model for testing – Playing pool and consulting oracles – Is complete testing possible – The Consequence of bugs – Taxonomy of Bugs.

UNIT II	TESTING FUNDAMENTALS	9

Software testing Fundamentals – Test case Design – Introduction of Black Box Testing and White Box testing – Flow Graphs and Path testing – Path testing Basics - Predicates, Path Predicates and Achievable Paths - Path Sensitizing – Path Instrumentation – Implementation and Application of Path Testing

UNIT III	TRANSACTION FLOW	9

Transaction Flow testing – Transaction Flows – techniques – Implementation Comments – Data Flow Testing – Basics – Strategies – Applications, Tools and effectiveness – Syntax Testing – Why, What, How – Grammar for formats – Implementation – Tips

UNIT IV	LOGIC TESTING	9

Logic Based Testing – Motivational Overview – Decision tables – Path Expressions – KV Charts – Specifications – States, State Graphs and transition Testing – State Graphs – Good & bad states – state testing Metrics and Complexity

UNIT V	TESTING TYPES	9

Testing GUIs – Testing Client – Server Architecture – Testing for Real-time System – A Strategic Approach to Software testing – issues – unit testing – Integration Testing – Validation testing – System testing – The art of Debugging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1	Understand the fundamentals of software testing
CO2	Gain software testing experience by applying software testing knowledge and methods to practice-oriented software testing projects.
CO3	Analyze path testing concept.
CO4	Analyze state testing concept.
CO5	Execute programs and test data in Client-Server Architecture.
CO6	Analyze The art of Debugging.

TEXT BOOKS:	
1	Boris Beizer, Software testing techniques, DreamTech Press, Second Edition – 2003.
2	Myers and Glenford.J., The Art of Software Testing, John-Wiley & Sons,1979.
REFERENCE BOOKS:	
1	Roger.S.Pressman, Software Engineering – A Practitioner's Approach,McGraw Hill, 5th edition, 2001.
2	Marnie.L. Hutcheson, Software Testing Fundamentals, Wiley-India,2007.

P23CAE16	ADVANCED OPERATING SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To Understand the concepts of clocks
2	To Understand the Various algorithms
3	To understand the Algorithms for Implementing Distributed Shared Memory
4	To understand the Handling Resource Sharing
5	Cloud Operating Systems Cloud Operating Systems

UNIT I	INTRODUCTION	9

Distributed Operating Systems – Issues – Communication Primitives – Limitations of a Distributed System – Lamport's Logical Clocks – Vector Clocks – Causal Ordering of Messages.

UNIT II	DISTRIBUTED OPERATING SYSTEMS	9

Distributed Mutual Exclusion Algorithms – Classification – Preliminaries – Simple Solution – Lamport's Algorithm – Ricart-Agrawala Algorithm – Suzuki-Kasami's Broadcast Algorithm – Raymond's Tree-Based Algorithm – Distributed Deadlock Detection – Preliminaries – Centralized Deadlock Detection Algorithms – Distributed Deadlock Detection Algorithms – Path Pushing Algorithm – Edge Chasing Algorithm – Hierarchical Deadlock Detection Algorithms – Agreement Protocols – Classification – Solutions to the Byzantine Agreement Problem – Lamport-Shostak- Pease Algorithm.

UNIT III	DISTRIBUTED RESOURCE MANAGEMENT	9

Distributed File Systems – Design Issues – Google File System – Hadoop Distributed File System– Distributed Shared Memory – Algorithms for Implementing Distributed Shared Memory – Load Distributing Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – No blocking Commit Protocol

UNIT IV	REAL TIME OPERATING SYSTEMS	9

Basic Model of Real - Time Systems – Characteristics – Application of Real - Time Systems – Real - Time Task Scheduling – Handling Resource Sharing

UNIT V	MOBILE AND CLOUD OPERATING SYSTEMS	9

Android – Overall Architecture – Linux Kernel – Hardware Support – Native User-Space – Dalvik and Android's Java – System Services – Introduction to Cloud Operating Systems

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Identify the features of distributed operating systems.
CO2	Demonstrate the various protocols of distributed operating systems.
CO3	Identify the different features of real time operating systems.
CO4	Discuss the features of mobile operating systems.
CO5	Discuss the features of cloud operating systems.
CO6	Understand about the distributed OS.

TEXT BOOKS:

1	Douglas Adeney, Computer and Information Ethics, Greenwood Press,FirstEdition1997.

2	Barger, Robert. (2008). Computer ethics: A case–based approach. Cambridge University Press 1stEdition.
REFERENCE BOOKS:	
1	Caroline Whitback, ”Ethics in Engineering Practice and Research“, Cambridge University Press, 2nd Edition 2011
2	George Reynolds, “Ethics in Information Technology”, Cengage Learning, 6thEdition 2018.
3	Barger, Robert. (2008). Computer ethics: A case–based approach.Cambridge University Press 1stEdition.
4	John Weckert and Douglas Adeney, Computer and Information Ethics, Greenwood Press,FirstEdition1997.

P23CAE17	E - LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To learn the various E-learning approaches and Components.
2	To explore Design Thinking.
3	To understand the types of design models of E-learning.
4	To learn about E-learning Authoring tools.
5	To know about evaluation and management of E-learning solutions

UNIT I	INTRODUCTION	9

Need for E-Learning – Approaches of E-Learning – Components of E-Learning –synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Workflow to Produce and Deliver E-Learning Content – Design Thinking: Introduction – Actionable Strategy – Act to Learn – Leading Teams to Win

UNIT II	DESIGNING E-LEARNING COURSE CONTENT	9

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study

UNIT III	CREATING INTERACTIVE CONTENT	9

Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests–Adding Additional Resources – Courseware Development Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool.

UNIT IV	LEARNING PLATFORMS	9

Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

UNITV	COURSE DELIVERY AND EVALUATION	9

Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning – Course Evaluation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Explain influence of software architecture on business and technical activities
CO2	Summarize quality attribute workshop
CO3	Identify key architectural structure
CO4	Use styles and views to specify architecture
CO5	Design document for a given architecture
CO6	Use Architectural Description Languages

TEXT BOOKS:	
1	Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views and Beyond", 2nd Edition, Addison–Wesley, 2010.
2	A Practitioner's Guide", 1st Edition, Auerbach Publications, 2010.
REFERENCE BOOKS:	
1	Len Bass, Paul Clements, and Rick Kazman, "Software Architectures Principles and Practices", 2n Edition, Addison–Wesley, 2003
2	Anthony J Lattanze, "Architecting Software Intensive System. A Practitioner's Guide", 1st Edition, Auerbach Publications, 2010.
3	Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views andBeyond", 2nd Edition, Addison–Wesley, 2010.
4	Paul Clements, Rick Kazman, and Mark Klein, "Evaluating software architectures: Method and case studies.",1st Edition, Addison–Wesley, 2001

P23CAE18	BUSINESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	To understand the basics of business analytics and its life cycle
2	To gain knowledge about fundamental business analytics.
3	To learn modeling for uncertainty and statistical inference.
4	To understand analytics using Hadoop and Map Reduce frameworks.
5	To acquire insight on other analytical frameworks.

UNIT I	OVERVIEW OF BUSINESS ANALYTICS	9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

UNIT II	ESSENTIALS OF BUSINESS ANALYTICS	9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

UNIT III	MODELING UNCERTAINTY AND STATISTICAL INFERENCE	9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – RandomVariables – Discrete Probability Distributions – Continuous Probability Distribution –Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

UNIT IV	ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK	9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to Map Reduce –Features of Map Reduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to Map Reduce

UNITV	OTHER DATA ANALYTICAL FRAMEWORKS	9

Overview of Application development Languages for Hadoop – Pig Latin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1	Identify the real world business problems and model with analytical solutions.
CO2	Solve analytical problems with relevant mathematics background knowledge.
CO3	Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
CO4	Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
CO5	Use open source frameworks for modeling and storing data
CO6	Overview of Application development Languages for Hadoop

TEXT BOOKS:	
1	An Integrated Approach to Software Engineering, PankejJalote, Narosa Publishing House, New Delhi 1997.
2	Making Sense of Software Quality Assurance, Raghav J. Nandyal, Tata McGRAW Hill, 2007
REFERENCE BOOKS:	
1	Metrics and Models in Software Quality Engineering, Stephan H. Kan, Pearson Education, 2007.
2	An Integrated Approach to Software Engineering, PankejJalote, Narosa Publishing House, New Delhi 1997.
3	Making Sense of Software Quality Assurance, Raghav J. Nandyal, Tata McGRAW Hill, 2007

P23CAE21	EMBEDDED SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	Present the introduction to embedded systems
2	Enable the students learn the embedded systems concepts and fundamentals.
3	Devices and Buses for Device Networks, Program modelling concepts
4	process communication & Synchronization of processes
5	Inter Tasks and threads

UNIT I	INTRODUCTION	9

Introduction to Embedded Systems: Embedded System – Processor in the system – Other hardware units – software embedded into a system – Exemplary Embedded systems – On chip and in VLSI Circuit. Processor and Memory selection for Embedded systems.

UNIT II	NETWORKS	9

Devices and Buses for Device Networks: I/O devices – Timer and counting Devices. Device Drivers and Interrupts Servicing Mechanism: Device drivers – Parallel Port device drivers in system – Serial Port device in a system – Device drivers for internal programmable timing devices – Interrupt servicing mechanism – context and the periods for context-switching, deadline and interrupt latency.

UNIT III	PROGRAMMING MODEL	9

Program modeling concepts in single & Multiprocessor systems software- Development Process: Modeling Processes for Software analysis before software Implementation – Programming models for event controlled or response time constrained real time programs – Modeling for microprocessor systems. Software Engineering Practices in the Embedded Software Development Process: Software algorithm complexity – Software Development process life cycle and its models – Software analysis – Software design – Software implementation – Software Testing, Validating and Debugging – Real time programming issues during the software development process – Software project management – Software maintenance – UML.

UNIT IV	REAL TIME OPERATING SYSTEMS	9

Inter – process communication & Synchronization of processes, Tasks and threads: Multiple processes in an application – Problem of sharing data by multiple tasks and routines – Inter Process communication. REAL TIME OPERATING SYSTEM:- Real time and Embedded systems operating systems – Interrupt routines in RTOS environment – RTOS Task scheduling models, Interrupt latency and Response times of the Tasks as performance Metrices – performance Metric in scheduling models for periodic, sporadic and Aperiodic Tasks – IEEE standard POSIX 1003.1b functions for Standardization of RTOS and Inter-task communication functions – List of Basic actions in a preemptive scheduler and Expected times taken at a processor – Filters – point strategy for synchronization between the processes, ISRs, OS functions and tasks and for Resource management – Embedded Linux Internals.

UNITV	EMBEDDED SYSTEM	9

Hardware – Software co-design in an embedded System: Embedded System Project Management – Embedded system design and co-design issues in system development processes – Design cycle in the development phase for an Embedded system – Uses of Target system, or its Emulator and In-circuit
Emulator – Use of software tools for development of an embedded system – Use of scopes and logic analysis for system hardware tests – Issues in Embedded system design Case Study: An Embedded System for an Adaptive cruise control system in a car, embedded system for a smart card.

	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
On the successful completion of the course, student will be able to:	
CO1	Understand embedded systems concepts
CO2	Understand RTOS concepts
CO3	Identify the devices and buses used in embedded networking
CO4	Analyze on software development process life cycle and its models
CO5	Analyze and design various real time embedded systems using RTOS
CO6	Analyze embedded system for a smart card.
TEXT BOOKS:	
1	Raj Kamal, "Embedded Systems – Architecture, programming and design", Tata McGraw – Hill, 2003.
2	David E. Simon, "An Embedded Software primer" Pearson Education Asia, 2003.
REFERENCE BOOKS:	
1	Kenneth J Ayala, "The 8051 Microcontroller and Architecture programming and application", Second Edition, Penram International.
2	David E. Simon, "An Embedded Software primer" Pearson Education Asia, 2003.

P23CAE22	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	The primary objective of this course is to introduce the basic principles
2	Techniques, and applications of Artificial Intelligence
3	Emphasis will be placed on the teaching of these fundamentals
4	Not on providing a mastery of specific software tools
5	Not on providing a programming environments.

UNIT I	INTRODUCTION	9

What Is AI? - Foundations of Artificial Intelligence-The History of Artificial Intelligence- The State of the Art- Risks and Benefits of AI. Intelligent Agents: Agents and Environments - The Concept of Rationality - The Nature of Environments- The Structure of Agents.

UNIT II	SOLVING PROBLEM BY SEARCHING	9

Problem-Solving Agents - Example Problems - Search Algorithms: Best-first search - Search data structures - Redundant paths - Measuring problem-solving performance - Uninformed Search Strategies: BFS-DFS-Depth limited and iterative deepening search. Heuristic Search Strategies: Greedy best-first search - A* search - Search contours - Inadmissible heuristics and weighted A* - Heuristic Functions.

UNIT III	LOCAL SEARCH AND OPTIMIZATION PROBLEMS	9

Hill-climbing search - Simulated annealing - Local beam search - Local Search in Continuous Spaces - Search with Nondeterministic Actions: The erratic vacuum world - AND—OR search trees. Optimal Decisions in Games: The minimax search algorithm - Optimal decisions in multiplayer games - Alpha--Beta Pruning. Heuristic Alpha--Beta Tree Search: Evaluation functions - Cutting off search - Forward pruning - Monte Carlo Tree Search - Stochastic Games- Limitations of Game Search Algorithms.

UNIT IV	CONSTRAINT SATISFACTION PROBLEMS	9

Defining Constraint Satisfaction Problems - Constraint Propagation: Inference in CSPs - Backtracking Search for CSPs - Local Search for CSPs - The Structure of Problems. Logical agent and Logics: Propositional Logic - Propositional Theorem Proving - Effective Propositional Model Checking - Agents Based on Propositional Logic - First-Order Logic: Syntax and Semantics of First-Order Logic - Using First-
Order Logic - Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Unification and First-Order Inference - Forward Chaining - Backward Chaining – Resolution.

UNITV	KNOWLEDGE REPRESENTATION AND REASONING	9

Ontological Engineering - Categories and Objects - Events - Mental Objects and Modal Logic - Reasoning Systems for Categories - Reasoning with Default Information. Automated Planning: Definition of Classical Planning - Algorithms for Classical Planning - Heuristics for Planning. Quantifying Uncertainty: Acting under Uncertainty - Basic Probability Notation - Inference Using Full Joint Distributions - Independence - Bayes' Rule and Its Use - Naive Bayes Models
Recommended Texts

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
On the successful completion of the course, student will be able to:	
CO1	After successful completion of this course
CO2	the students should be able to Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations
CO3	Apply basic principles of AI in solutions that require problem solving
CO4	inference, perception
CO5	knowledge representation, and learning.
CO6	Definition of Classical Planning
TEXT BOOKS:	
1	Stuart Russel and Peter Norvig: Artificial Intelligence – A Modern Approach- 4th Edition Pearson Education, 2020.
2	Elaine Rich and Kevin Knight: Artificial Intelligence- Tata McGraw Hill 2nd Ed, 1991.
REFERENCE BOOKS:	
1	Elaine Rich and Kevin Knight: Artificial Intelligence- Tata McGraw Hill 2nd Ed, 1991.
2	N.P. padhy: Artificial Intelligence and Intelligent Systems- Oxford Higher Education- Oxford University Press, 2005.
3	George F Luger: Artificial Intelligence- Structures and Strategies for complex Problem Solving- 4 th Ed. Pearson Education, 2002.
4	Stuart Russel and Peter Norvig: Artificial Intelligence – A Modern Approach- 4th Edition Pearson Education, 2020.

P23CAE23	SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
2	Introduce students to artificial neural networks and fuzzy theory from an engineering perspective
3	Input Space Partitioning and Fuzzy Modeling.
4	Downhill Simplex Search.
5	Framework Neuron Functions for Adaptive Networks Neuro Fuzzy Spectrum.

UNIT I	FUZZY SET THEORY	9

Introduction to Neuro, Fuzzy and Soft Computing, Fuzzy Sets, Basic function and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

UNIT II	OPTIMIZATION	9

Derivative based Optimization, Descent Methods, and The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, and Random Search, Downhill Simplex Search.

UNIT III	ARTIFICIAL NEURAL NETWORKS	9

Introduction and ANN Structure, Biological neurons and artificial neurons. Model of an ANN, Activation functions used in ANNs, Typical classes of network architectures, Single layer perceptrons, Structure and learning of perceptrons. Feed forward ANN, Structures of Multi-layer feed forward networks, back propagation algorithm, Back propagation - training and convergence.

UNIT IV	NEURO FUZZY MODELING	9

Adaptive Neuro-Fuzzy Inference Systems, Architecture Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks Neuro Fuzzy Spectrum.

UNITV	APPLICATIONS OF COMPUTATIONAL INTELLIGENCE	9

Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Coloripe Prediction.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1	Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
CO2	Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
CO3	To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
CO4	Understand appropriate learning rules for each of the architectures and learn several

	neural network paradigms and its applications
CO5	Reveal different applications of these models to solve engineering and other problems.
CO6	Soft Computing for Coloripe Prediction.

TEXT BOOKS:	
1	"Neuro-Fuzzy and Soft Computing", J.S.R.Jang, C.T.Sun and E.Mizutani, PHI, 2004, Pearson Education 2004
2	Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

REFERENCE BOOKS:	
1	"Artificial Intelligence and Intelligent Systems", N.P.Padhy, Oxford University Press, 2006
2	Artificial Intelligence, Second Edition, Elaine Rich & Kevin Knight, Tata McGraw Hill Publishing Comp., New Delhi, , 2nd edition-2006
3	"Fuzzy Logic with Engineering Applications", Timothy J.Ross, McGraw-Hill, 3 rd edition-1997

P23CAE24	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To gain knowledge about social networks, its structure and their data sources.
2	To study about the knowledge representation technologies for social network analysis.
3	To analyze the data left behind in social networks.
4	To gain knowledge about the community–maintained social media resources.
5	To learn about the visualization of social networks.

UNIT I	INTRODUCTION TO SEMANTIC WEB	9

The development of Semantic Web – Emergence of the Social Web – The Development of Social Network Analysis – Basic Graph Theoretical Concepts of Social Network Analysis – Electronic Sources for Network Analysis – Electronic Discussion Networks, Blogs and Online Communities.

UNIT II	KNOWLEDGE REPRESENTATION ON THE SEMANTIC WEB	9

Ontology–based knowledge Representation – Ontology languages for the Semantic Web: RDF and OWL.

UNIT III	SOCIAL NETWORK MINING	9

Detecting Communities in Social Network – Evaluating Communities –Methods for Community Detection – Applications of Community Mining Algorithms – Tools for detecting communities – Application: Mining Face book.

UNIT IV	COMMUNITY MAINTAINED SOCIAL MEDIA RESOURCES	9

Community Maintained Resources – Supporting technologies for community maintained resources– User motivations–Location based social interaction – location technology– mobile location sharing – Automated recommender system.

UNITV	VISUALIZATION OF SOCIAL NETWORKS	9

Visualization of Social Networks – Node–Edge Diagrams – Random Layout – Force–Directed Layout – Tree Layout – Matrix Representations –Matrix and Node–Link Diagrams– Visualizing Online Social Networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	create entities and relationships of data as network and do analysis.
CO2	Model and represent knowledge for social semantic Web.
CO3	Use extraction and mining tools for analyzing Social networks.
CO4	Collect data from various social media resources and analyze.
CO5	Develop personalized visualization for Social networks.
CO6	Supporting technologies for community maintained resources.

TEXT BOOKS:	
1	Waltham, MA: Morgan Kaufmann (Elsevier),First Edition, 2013
2	CharuAggarwal, "Social Network Data Analytics," Springer, First Edition, 2014
REFERENCE BOOKS:	
1	Matthew A. Russell,"Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn,Google+, Githuband more", O'REILLY, Third Edition, 2018.
2	CharuAggarwal, "Social Network Data Analytics," Springer, First Edition, 2014
3	Jennifer Golbeck, "Analyzing the social web", Waltham, MA: Morgan Kaufmann (Elsevier),First Edition, 2013
4	BorkoFurht, "Handbook of Social Network Technologies and Applications", Springer, FirstEdition, 2010.

P23CAE25	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	Learn digital image fundamentals.
2	Be exposed to simple image processing techniques.
3	Learn to represent image enhancement in the spatial and frequency domain.
4	Be familiar with image segmentation and compression techniques.
5	Be familiar Color Image fundamentals.

UNIT I	DIGITAL IMAGE FUNDAMENTALS	9

Elements of visual perception, Image Acquisition Systems, Sampling and Quantization, Image Formation, Image Geometry, Different types of digital images. Relationship between pixels, Basic concepts of distance transform, Color Image fundamentals–RGB–HIS Models, Different color models–conversion.

UNIT II	IMAGE TRANSFORMS	9

1D Discrete Fourier Transform (DFT), 2D transforms – DFT, Discrete Cosine Transform, Walsh and PCA.

UNIT III	IMAGE ENHANCEMENT	9

Gray Level transformations, Histogram Equalization, Spatial Domain: Basics of Spatial Filtering: smoothing and sharpening spatial filters.
Frequency domain: smoothing and sharpening frequency domain filters, Ideal, Gaussian filters.

UNIT IV	IMAGE SEGMENTATION AND FEATURE EXTRACTION	9

Segmentation: Point detection, line detection, edge detection, Region based segmentation, Region Splitting and Merging Technique. Thresholding Techniques: multilevel thresholding, optimal thresholding using Bayesian classification. Feature Extraction: GLCM, Hough Transform, Morphological operation

UNITV	IMAGE COMPRESSING	9

Lossy and lossless compression schemes, prediction based compression schemes, sub–band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Digitize the input image using appropriate sampling and quantizing techniques
CO2	Transform the input images to various domains and classify the images
CO3	Enhance the images using spatial domain and frequency domain for better visual representation
CO4	To extract the features of a image by applying Morphological Image Processing techniques.
CO5	Analyze the different image compression techniques and its significance
CO6	Analyze JPEG compression standard.

TEXT BOOKS:	
1	John C.Russ, "The Image Processing Handbook", 5thEdition, Prentice Hall, New Jersey,2002
2	Jain Anil K.,"Fundamentals of Digital Image Processing", 1st Edition, Prentice Hall of India,New Delhi, 2002
REFERENCE BOOKS:	
1	Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", 4th Edition, PearsonEducation, New Delhi, 2018.
2	Jain Anil K.,"Fundamentals of Digital Image Processing", 1st Edition, Prentice Hall of India,New Delhi, 2002
3	Kenneth R.Castleman, "Digital Image Processing", 1st Edition, Prentice Hall of India, NewDelhi, 2006.
4	John C.Russ, "The Image Processing Handbook", 5thEdition, Prentice Hall, New Jersey,2002

P23CAP21	ADVANCED DATABASE TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	Design a distributed database system and execute distributed queries.
2	Manage Spatial and Temporal Database systems and implement it in corresponding applications.
3	Use NoSQL database systems and manipulate the data associated with it.
4	Design XML database systems and validate with XML schema.
5	Apply knowledge of information retrieval concepts on web databases.

LIST OF EXPERIMENTS

1	Creation of base tables and views.
2	Data Manipulation INSERT, DELETE and UPDATE in Tables. SELECT, Sub Queries and JOIN
3	Data Control Commands
4	High level language extensions – PL/SQL. Or Transact SQL – Packages
5	Use of Cursors, Procedures and Functions 6. Embedded SQL or Database Connectivity.
6	Oracle or SQL Server Triggers – Block Level – Form Level Triggers
7	Working with Forms, Menus and Report Writers for a application project in any domain
8	Front–end tools – Visual Basic/Developer 200.
9	Query Evaluation Plan
10	Concurrency and Transactions

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1	64-bit Open source Linux or its derivative.	
2	Open Source C++ Programming tool like G++/GCC.	

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Design and implement advanced databases.
CO2	Use big data frameworks and tools.
CO3	Formulate complex queries using SQL.
CO4	Create an XML document and perform XQuery.
CO5	Query processing in Mobile databases using open source tools.
CO6	Apply knowledge of information retrieval concepts on web databases.

P23CAP22	FULL STACK WEB DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	To implement the client side of the web application using JavaScript.
2	To understand JavaScript on the desktop using NodeJS.
3	To develop a web application using NodeJS and Express.
4	To implement a SPA using React.
5	To develop a full stack single page application using React, NodeJS, and a Database(MongoDB or SQL).

LIST OF EXPERIMENTS

1	Create a form and validate the contents of the form using JavaScript.
2	Get data using Fetch API from an open–source endpoint and display the contents in the form of a card.
3	Create a NodeJS server that serves static HTML and CSS files to the user without using Express.
4	Create a NodeJS server using Express that stores data from a form as a JSON file and displays it in another page. The redirect page should be prepared using Handlebars.
5	Create a NodeJS server using Express that creates, reads, updates and deletes students' details and stores them in MongoDB database. The information about the user should be obtained from a HTML form.
6	Create a NodeJS server that creates, reads, updates and deletes event details and stores them in a MySQL database. The information about the user should be obtained from a HTML form.
7	Create a counter using ReactJS
8	Create a To-do application using ReactJS. Store the data to a JSON file using a simple NodeJS server and retrieve the information from the same during page reloads.
9	Create a simple Sign up and Login mechanism and authenticate the user using cookies. The user information can be stored in either MongoDB or MySQL and the server should be built using NodeJS and Express Framework.
10	Create and deploy a virtual machine using a virtual box that can be accessed from the host computer using SSH.
11	Create a docker container that will deploy a NodeJS ping server using the NodeJS image.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1	Processors: Intel Atom® processor or Intel® Core™ i3 processor.	
2	Disk space: 1 GB	
3	Operating systems: Windows* 7 or later, macOS, and Linux	
4	Python* versions: 27.X, 36.X.,38.X	

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	To implement and deploy the client side of the web application.
CO2	To develop and deploy server side applications using NodeJS.
CO3	To use Express framework in web development.
CO4	To implement and architect database systems in both NoSQL and SQL environments.
CO5	To develop a full stack single page application using React, NodeJS, and a Database and deploy using containers.
CO6	Create a form and validate the contents of the form using JavaScript.

SEMESTER III

P23CAT32	INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	Understand the core principles and framework of Industry 4.0 and its impact on manufacturing and other industrial sectors.
2	Explore key enabling technologies such as IOT, AI/ML, robotics, cloud computing, digital twins, and data analytics.
3	Analyse the role of smart factories and the concept of digital transformation in modern industry.
4	Gain insights into the challenges and opportunities of implementing Industry 4.0 in real-world scenarios
5	Develop strategies for integrating Industry 4.0 technologies into existing business and production models.

UNIT I	INTRODUCTION TO INDUSTRY 4.0	9

Definition of Industry 4.0 – Developments in USA, Europe, China and other countries – Comparison of Industry 4.0 Factory and today's Factory – 10 most important things that will change with Industry 4.0 – Difference between conventional automation and Industry 4.0.

UNIT II	INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM	9

Internet Introduction to Cyber Physical Systems (CPS), Architecture of CPS– Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain.

UNIT III	THE SMART WORKPIECE	9

Introduction to Intelligent work piece – The intelligent work piece as basic functionality in implementing Industry 4.0 – Work piece tagging – QR codes and RFID – Communication between work piece and environment – Multi–agent systems – Applications for smart work pieces.

UNIT IV	INTEROPERABILITY: COMMUNICATION SYSTEMS AND STANDARDS FOR INDUSTRY 4.0 AND CLOUD APPLICATIONS	9

Industrial communication – Industrial Internet of Things (IIOT) – The Industry 4.0 Reference Architecture Model RAMI4.0 – Basics on Service oriented Architecture – OPC–UA as future standard in Industry 4.0 – Machine to machine interaction in practice.

UNITV	CLOUD MANUFACTURING AND THE CONNECTED FACTORY	9

Virtualization – Cloud Platforms – Big data in production – Cloud–based ERP and MES solutions – Connected factory applications – IT security for cloud applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Understand the basic concepts of Industry 4.0 and the other related fields.
CO2	Understand cyber physical system and the emerging applications.
CO3	Analyze the communication between intelligent work piece and its environment.
CO4	Implement the industry 4.0 to solve IT security issues in cloud application.

CO5	Analyze the basics of service oriented architecture.
CO6	Analyze IT security for cloud applications.

TEXT BOOKS:	
1	Jean-Claude André. Released July 2019. Publisher(s): Wiley-ISTE. ISBN: 9781786304827.
2	M Gordan · 2023 — **Industry 4.0** Perspectives and Applications Edited by Meisam Gordan, Khaled Ghaedi.

REFERENCE BOOKS:	
1	Industry 4.0: The Industrial Internet of Things, by Alasdair Gilchrist. 2016, Publisher(s): Apress
2	Jean-Claude André. Released July 2019. Publisher(s): Wiley-ISTE. ISBN: 9781786304827.
3	M Gordan · 2023 — **Industry 4.0** Perspectives and Applications Edited by Meisam Gordan, Khaled Ghaedi
4	A Gilchrist · Cited by 1464 — This book explores the potential for the Internet of Things (IoT), Big Data, Cyber-Physical Systems (CPS).

P23CAT33	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To Implementing research process and design.
2	To Use Sampling and methods.
3	To do examining and displaying.
4	To use IPR concepts to Evolution and development.
5	Apply function of UNESCO in IPR maintenance.

UNIT I	RESEARCH DESIGN	9

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II	DATA COLLECTION AND SOURCES	9

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data – Preparing, Exploring, examining and displaying.

UNIT III	DATA ANALYSIS AND REPORTING	9

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV	INTELLECTUAL PROPERTY RIGHTS	9

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNITV	PATENTS	9

Patents – COURSE OBJECTIVES and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E–filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Analyze the Registration of patent agents.
CO2	Understand the Functions of UNESCO in IPR maintenance.
CO3	Analyze Questionnaires and Instruments.
CO4	Use Types and Features of IPR Agreement.
CO5	Understand the Benefits of patent, Concept, features of patent.
CO6	Use Hypotheses testing and Measures of Association.

TEXT BOOKS:	
1	Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007
2	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.

REFERENCE BOOKS:	
1	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2	Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007
3	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013

P23CAT34	DATA SCIENCE & ANALYTICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the techniques and processes of data science
2	To apply descriptive data analytics
3	To visualize data for various applications
4	To understand inferential data analytics
5	To analysis and build predictive models from data

UNIT I	INTRODUCTION TO DATA SCIENCE	9

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II	DESCRIPTIVE ANALYTICS	9

Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean

UNIT III	INFERENTIAL STATISTICS	9

Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size

UNIT IV	ANALYSIS OF VARIANCE	9

t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Twofactor experiments – three f-tests – two-factor ANOVA –Introduction to chi-square tests.

UNITV	PREDICTIVE ANALYTICS	9

Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to	
CO1	Explain the data analytics pipeline
CO2	Describe and visualize data
CO3	Perform statistical inferences from data
CO4	Analyze the variance in the data
CO5	Build models for predictive analytics
CO6	Using data tables library.

TEXT BOOKS:	
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (first two chapters for Unit I).
2	Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016

REFERENCE BOOKS:	
1	Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
2	Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
3	Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.
4	Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress, 2021.

P23CAE33	DEVOPS AND MICROSERVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To introduce Micro services and Containers.
2	To understand the key concepts and principles of Dev Ops
3	To be familiar with most common Dev Ops tools
4	To explain the business benefits of Dev Ops and continuous delivery.
5	To recall specific Dev Ops methodologies and frameworks

UNIT I	INTRODUCTION TO MICROSERVICES	9

DefinitionofMicroservices–Characteristics–MicroservicesandContainers–InteractingwithOther Services–Monitoring and Securing the Services–Containerized Services–Deploying on Cloud

UNIT II	MICROSERVICESARCHITECTURE	9

Monolithic architecture– Micro services architectural style– Benefits – Drawbacks of Micro services architectural style – decomposing monolithic applications into Micro services

UNIT III	DEV OPS TOOLS	9

History of Dev Ops– Dev Ops and Software Development Life Cycle – Waterfall Model _Agile Model – Dev Ops Life Cycle – Dev Ops Tools: distributed version of control tool Git– Automation testing tools– Selenium – report generation –Testing – User Acceptance Testing – Jenkins

UNIT IV	MICROSERVICESIN DEVOPS ENVIRONMENT	9

Evolution of Micro services and DevOps – Benefits of combining Dev Ops and Micro services– working of DevOps and Micro services in Cloud environment – DevOps Pipeline representation for a NodeJS based Micro services

UNITV	VELOCITYAND CONTINUOUS DELIVERY	9

Velocity–DeliveryPipeline–teststack–Small/UnitTest–medium/integrationtesting– system testing– Job of Development and DevOps–Job of Test and DevOps–Job of Opand Devops–Infrastructure and the job of Ops.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Select the Microservices design and apply the principles..
CO2	Apply Microservices in DevOps
CO3	Understand about DevOps and the common tools use din DevOps.
CO4	Develop and integrate projects using DevOps
CO5	Develop and integrate projects using DevOps
CO6	Deploy and monitor projects using DevOps

TEXT BOOKS:

1	JamesAScott, APracticalGuidetoMicroservicesandContainers, MapRDataTechnologies e–book. https://mapr.com/ebook/microservices–and–containers/assets/microservices–and– containers.pdf
2	Joyner Joseph, Devops for Beginners ,First Edition,MihailsKonoplovspublisher,2015.

REFERENCE BOOKS:	
1	Namit Tanasseri, RahulRai, Microservices with Azure, 1st Edition, Packt Publishing,UK, 2017
2	EberhardWolff,Microservices:FlexibleSoftwareArchitecture,1st Edition ,Pearson Education,2017
3	JamesAScott,APracticalGuidetoMicroservicesandContainers,MapRDataTechnologies e–book. https://mapr.com/ebook/microservices–and–containers/assets/microservices–and– containers.pdf
4	Joyner Joseph, Devops for Beginners ,First Edition,MihailsKonoplovspublisher,2015.

P23CAE34	CYBER FORENSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To learn computer forensics
2	To become familiar with forensics tools
3	To learn to analyze and validate forensics data
4	To learn Traditional Computer Crime
5	To learn Forensic duplication and investigation

UNIT I	INTRODUCTION TO COMPUTER FORENSICS	9

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR:
Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II	EVIDENCE COLLECTION AND FORENSICS TOOLS	9

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III	ANALYSIS AND VALIDATION	9

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

UNIT IV	ETHICAL HACKING	9

Introduction to Ethical Hacking – Foot printing and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing

UNITV	ETHICAL HACKING IN WEB	9

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Understand the basics of computer forensics
CO2	Apply a number of different computer forensic tools to a given scenario
CO3	Analyze and validate forensics data
CO4	Identify the vulnerabilities in a given network infrastructure
CO5	Implement real-world hacking techniques to test system security
CO6	Identify the Cell Phone and Mobile Devices Forensics

TEXT BOOKS:

1	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2	CEH official Certfied Ethical Hacking Review Guide, Wiley India Edition, 2015.

REFERENCE BOOKS:	
1	John R.Vacca, ―Computer Forensics‖, Cengage Learning, 2005
2	MarjieT.Britz, ―Computer Forensics and Cyber Crime‖: An Introduction‖, 3rd Edition, Prentice Hall, 2013.
3	AnkitFadia ― Ethical Hacking‖ Second Edition, Macmillan India Ltd, 2006
4	Kenneth C.Brancik ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group–2008.

P23CAE35	BIO-INSPIRED LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To learn bio-inspired algorithms , random walk and simulated annealing
2	To learn genetic algorithm and differential evolution
3	To learn swarm optimization and ant colony for feature selection
4	To understand bio-inspired application in image processing
5	To understand Optimization algorithm

UNIT I	BIO-INSPIRED COMPUTING FUNDAMENTALS	9

Introduction to Computing - Algorithm - Newton's method - Optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Meta-heuristics - Analysis of Algorithms -Nature Inspired Algorithms - Parameter tuning - parameter control- Example of Bio-inspired computing.

UNIT II	RANDOM WALK AND ANNEALING	9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - Step sizes and search efficiency - Modality and intermittent search strategy - Importance of randomization- Eagle strategy- Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

UNIT III	GENETIC ALGORITHMS	9

Introduction to Genetic algorithms and - Role of genetic operators - Choice of parameters - GA variants - Schema theorem - Convergence analysis - Introduction to differential evolution - Variants - Choice of parameters - Convergence analysis - Implementation.

UNIT IV	SWARM OPTIMIZATION AND FIREFLY ALGORITHM	9

Biological self-organization - Swarm intelligence - PSO algorithm - Accelerated PSO - Implementation - Convergence analysis - Binary PSO - The Firefly algorithm - Algorithm analysis - Implementation - variants- Ant colony optimization toward feature selection-Swarm robotics– Artificial evolution of competing systems.

UNITV	APPLICATION IN IMAGE PROCESSING	9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Metaheuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm : Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Improved Weighted Thresholded Histogram Equalization Algorithm
CO2	Digital Image Contrast Enhancement Using Bat Algorithm
CO3	Ground Glass Opacity Nodules Detection and Segmentation using Snake Model
CO4	Ant colony optimization toward feature selection
CO5	Importance of randomization
CO6	Modality and intermittent search strategy

TEXT BOOKS:	
1	D. E. Goldberg, “Genetic algorithms in search, optimization, and machine learning”, Addison- Wesley, 1989
2	Yang, Cui,Xiao, Gandomi, Karamanoglu, “Swarm Intelligence and BioInspired Computing", Elsevier First Edition 2013.

REFERENCE BOOKS:	
1	Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2	Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013.
3	Xin-She Yang ,Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016.
4	Xin-She Yang, "Nature Inspired Optimization Algorithm,Elsevier First Edition 2014.

P23CAE36	DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	Demonstrate the major technology trends driving Deep Learning
2	Build, train and apply fully connected deep neural networks
3	Implement efficient (vectorized) neural networks
4	Analyze the key parameters and hyper parameters in a neural network's architecture
5	Analyze the Constrained Optimization

UNIT I	LINEAR ALGEBRA	9

Scalars, Vectors, Matrices and Tensors, Matrix operations, types of matrices, Norms, Eigen decomposition, Singular Value Decomposition, Principal Components Analysis. Probability and Information Theory: Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, Expectation, Variance and Covariance, Bayes' Rule, Information Theory. Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.

UNIT II	MACHINE LEARNING	9

Basics and Underfitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Bayesian Statistics, Supervised and Unsupervised Learning, Stochastic Gradient Descent, Challenges Motivating Deep Learning. Deep Feedforward Networks: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and other Differentiation Algorithms.

UNIT III	REGULARIZATION FOR DEEP LEARNING	9

Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier. Optimizationfor Training Deep Models: Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies andMeta-Algorithms.

UNIT IV	CONVOLUTIONAL NETWORKS	9

The Convolution Operation, Pooling, Convolution, Basic Convolution Functions, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Basis for Convolutional Networks.

UNITV	SEQUENCE MODELING	9

Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, LSTM, Gated RNNs, Optimization for Long-Term Dependencies, Auto encoders, Deep Generative Models.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Demonstrate the mathematical foundation of neural network
CO2	Describe the machine learning basics
CO3	Compare the different architectures of deep neural network
CO4	Build a convolutional neural network

CO5	Build and train RNN and LSTMs
CO6	Term Dependencies, Auto encoders
TEXT BOOKS:	
1	Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press,2016.
2	Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017.
REFERENCE BOOKS:	
1	Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Buduma, O’Reilly, Shroff Publishers, 2019.
2	Deep learning Cook Book, Practical recipes to get started Quickly, DouweOsinga, O’Reilly, Shroff Publishers, 2019.
3	Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press,2016.
4	Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017.

P23CAE37	ADVANCES IN NETWORKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the theme underlying IPv6 Structure and addressing methods
2	To understand andanalyzetheprotocolsforIPv6Implementation
3	To identify and provide solutions for QoS and Security Issues with IPv6
4	To learn about Software Defined concepts, architectures ,protocols and applications
5	To explore the significance of Network Function Virtualization

UNIT I	IPv6 STRUCTURE AND ADDRESSING	9

IPv4AddressDepletion–IPv6TransitionIssues–IPv6 Structure:IPv6 Header, Extension Headers :Hop–by–Hop Options Header, Destination Options Header, Routing Header, Fragment Header, AH, ESP–IPv6 Addresses: Unicast, Any cast, Multicast– Address Auto configuration

UNIT II	IPv6 NETWORKING	9

IPv6 Internet Control Message Protocol (ICMPv6): ICMPv6 Messages, Fragmentation and Path MTU– IPv6 Neighbor Discovery– IPv6 Routing :RIPng, EIGRP for IPv6, OSPFv3 – Mobile IPv6.

UNIT III	QoS, PROVISIONINGAND SECURITY WITH IPv6	9

QoS in IPv6 Protocols: Differentiated Services and IPv6, IPv6 Flows, Explicit Congestion Notification in IPv6 – Provisioning: StatelessDHCPv6, Stateful DHCPv6, DNS Extensions for IPv6– Security with IPv6: IP Security Protocol (IPsec) Basics, IPv6 Security Elements, Interaction of IPsec with IPv6 Elements.

UNIT IV	SOFTWARE DEFINED NETWORKING	9

Genesis of SDN – Separation of Control Plane and Data Plane – Distributed Control Plane –IP and MPLS – Characteristics of SDN – Operation – Devices – Controller – Open Flow Specification.

UNITV	NETWORK FUNCTIONVIRTUALIZATION	9

Building SDN Framework – Network Functions Virtualization – Introduction –Virtualization and Data Plane I/O – Service Locations and Chaining – Applications – Use Cases of SDNs: Data Centers, Overlays, Big Data and Network Function Virtualization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	DescribehowIPv6 interacts with data link layer with IPv6 Structure and addressing methods.
CO2	To develop the strategies for deploying IPv6 in the place of IPv4
CO3	Analyze the security issues for IPv6 in emerging applications
CO4	Analyze the need for separation of data and control plane in Networking
CO5	To use SDN to enable and enhance NFV
CO6	To Use Big Data and Network Function Virtualization.

TEXT BOOKS:	
1	Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publisher, FirstEdition2014
2	Thomas D.Nadeau, KenGray,"SDN: Software Defined Networks, An Authoritative Review of Network Programs ability Technologies", O'ReillyMedia,FirstEditionAugust2013
REFERENCE BOOKS:	
1	Rick Graziani,"IPv6 Fundamentals: A Straightforward Approach to Understanding IPv6"Second Edition, Cisco Press, 2017.
2	Peter Loshin, "IPv6:Theory,Protocol,and Practice" Second Edition, Morgan Kaufmann Publishers, 2004
3	William Stallings, "Foundations of Modern Networking – SDN, NFC, QoE, IoT and Cloud"Third Edition, Pearson Publications, 2019.
4	Oswald Coker, Siamak Azodolmolky, "Software–Defined Networking with Open Flow", Second Edition, Packt Publishing, 2017.

P23CAE41	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the basics of information retrieval with pertinence modeling, query operations and indexing
2	To get an understanding of machine learning techniques for text classification and clustering.
3	To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
4	To understand the concepts of digital libraries
5	To understand the Boolean Model

UNIT I	MOTIVATION	9

Basic Concepts–Practical Issues–Retrieval Process–Architecture–Boolean Retrieval– Retrieval Evaluation–Open Source IR Systems–History of Web Search– Web Characteristics–The impact of the web on IR—IR Versus Web Search–Components of a Search engine.

UNIT II	MODELING	9

Taxonomy and Characterization of IR Models–Boolean Model –Vector Model– Term Weighting–Scoring and Ranking–Language Models–Set The oretic Models–Probabilistic Models–AlgebraicModels–StructuredTextRetrievalModels–ModelsforBrowsing.

UNIT III	INDEXING	9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching–SequentialSearchingandPatternMatching.QueryOperations–QueryLanguages–QueryProcessing–RelevanceFeedbackandQueryExpansion–AutomaticLocalandGlobal Analysis–Measuring Effectiveness and Efficiency.

UNIT IV	CLASSIFICATIONANDCLUSTERING	9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering–Hierarchical Clustering– Matrix decompositions and latent semantic indexing–Fusion and Meta learning.

UNITV	SEARCHINGTHE WEBAND RETRIEVAL	9

Searching the Web–Structure of the Web–IR and web search– Static and Dynamic Ranking–Web Crawling and Indexing–Link Analysis–XML Retrieval Multimedia IR: Models and Languages–Indexing and Searching Parallel and Distributed IR– Digital Libraries

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Build an Information Retrieval system using the available tools.
CO2	Identify and design the various components of an Information Retrieval system.
CO3	Model an information retrieval system

CO4	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO5	Design an efficient search engine and analyze the Web content structure.
CO6	Indexing and Searching Parallel and Distributed IR.
TEXT BOOKS:	
1	RicardoBaeza–Yates,BerthierRibeiro–Neto,―ModernInformationRetrieval:The concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011
2	Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, ―Information Retrieval: Implementing and Evaluating Search Engines (The MIT Press), Illustrated Edition,2016.
REFERENCE BOOKS:	
1	Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, First Edition2010.
2	Manning D. Christopher, Raghavan Prabhakar &Schutz Hinrich,‟ Introduction to Information Retrieval” ,Cambridge University Press, OnlineEdition,2009.
3	David A. Grossman, Ophir Frieder, “Information Retrieval: Algorithms and Heuristics”, Springer, 2nd Edition, 2004
4	Bruce Croft ,Donald Metzler, Trevor Stroh man, “Search Engines: Information Retrieval in Practice”, Pearson,2009.

P23CAE42	DIGITAL MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the difference between Traditional Marketing and digital Marketing.
2	To understand and analyze these arch engine functions.
3	To develop a deep knowledge about the Digital marketing platforms and the theoretical aspects of creating a website.
4	To analyze inbuilt tools for digital Marketing.
5	To Use platforms for website creation.

UNIT I	INTRODUCTION TODIGITAL MARKETING	9

What is Digital Marketing–Need of Digital Marketing–Digital Marketing Platforms– Understanding digital marketing process–Difference between Traditional Marketing and digital Marketing– tools of Digital marketing – Advantage of Digital Marketing–Digital Marketing Manager Role and functions– How we use both Digital &Traditional Marketing.

UNIT II	WEBSITE &SEARCH ENGINE	9

Website–Hosting and Domain–Different platforms for website creation–Introduction to SERP– What are search engines–How search engines work–Major functions of a search engine– What are keywords–Different types of keywords–Google keyword planner tool.

UNIT III	MISC TOOLS– GOOGLE WEBMASTER TOOLS	9

Site Map Creators–Browser–based analysis tools–Page Rank tools–pinging & indexing tools– Dead links identification tools– Open site explorer Domain information/who is tools– Quick sprout.

UNIT IV	LEAD MANAGEMENT&DIGITAL MARKETING	9

Web to lead forms– Web to case forms–Lead generation techniques–Leads are everywhere– Social media and lead gen Inbuilt tools for Digital Marketing–Ip Tracker–CPC reduction(incase of paid ads) Group posting on Social Media platform

UNITV	TRENDINGDIGITAL MARKETING SKILLS	9

Search Engine Optimization(SEO)–Search Engine Marketing(SEM).–Social Media Marketing/Optimization– Email Marketing. Website: Product Marketing– Content Writing. Marketing the created content online Copywriting– Blogging– Local Marketing. Google Ad Words – Campaign Management– PPC Advertising– Affiliate Marketing. Mobile and SMS Marketing– Marketing Automation–Web Analytics– Growth Hacking

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	To gain in sight on the concept of digital marketing and the role of a digital manager.
CO2	To understand and administer the website and the search engines.
CO3	To understand how to use MISC and Google Webmaster tools.
CO4	To understand the concepts of lead management and digital marketing.
CO5	To gain knowledge on the latest digital marketing trends
CO6	To understand Affiliate Marketing.
TEXT BOOKS:	
1	Dodson, I.(2016).The art of digital marketing: the definitive guide to creating strategic, targeted, and measurable online campaigns. John Wiley & Sons.
2	Chaffey, D., &Smith ,P. R.(2017).Digital marketing excellence :planning, optimizing and Integrating online marketing. Taylor& Francis.
REFERENCE BOOKS:	
1	Chaffey, D. (2019).Digital marketing strategy, Implementation and Practice. Pearson
2	Chaffey, D., &Smith ,P. R.(2017).Digital marketing excellence :planning, optimizing and Integrating online marketing. Taylor& Francis.
3	Kaufman, I., & Horton, C. (2014).Digital marketing: Integrating strategy and tactics with values, a guide book for executives ,managers ,and students .Rout Ledge.
4	Royle, J.,& Laing, A.(2014).The digital marketing skills gap: Developing a Digital Marketer Model for the communication industries. International Journal of Information Management,34(2),65–73

P23CAE43	DATA VISUALIZATION AND TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the categories of data quality principles.
2	To describe data through visual representation.
3	To provide basic knowledge about how large data set are represented into visual graphics and easily understand the complex relationships within the data.
4	To design effective visualization techniques for any different problems
5	Understand the complex relationships within the data.

UNIT I	INTRODUCTION	9

Visualization–visualization process –role of cognition–Pseudo code conventions–Scatter plot– Data foundation: Types of data –Structure within and between records–Data preprocessing– Human perceptions and information processing.

UNIT II	VISUALIZATION FOUNDATIONS	9

Semiology of graphical Symbols–Eight Visual Variables–Historical Perspective–Visualization Techniques for spatial data– One–dimensional data–two dimensional data–Three dimensional data–dynamic data–combining techniques–Visualization of Geospatial data–Visualization of Point, line, area data

UNIT III	DESIGNING EFFECTIVE VISUALIZATION	9

Steps in Designing Visualization–problems in Designing Effective Visualization–Comparing and evaluating visualization techniques–Visualization System.

UNIT IV	INFORMATION DASHBOARD DESIGN	9

Characteristics of dash boards–Key goals in visual design process–Dash board display media– Designing dash boards for usability–Meaningful organization–Maintaining consistency– Aesthetics of dashboards–Testing for usability –Case Studies: Sales dashboard, Marketing analysis dash board.

UNITV	VISUALIZATION SYSTEMS	9

Systems based on Data type–systems based on Analysis type–Text analysis and visualization– Modern integrated visualization systems– toolkit–Research directions in visualization–issues of cognition, perception and reasoning–issues of evaluation–issues of Hardware.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Describe principles of visual perception
CO2	Apply visualization techniques for various data analysis tasks – numerical data
CO3	Apply visualization techniques for various data analysis tasks– Non numerical data
CO4	Design effective visualization techniques for different problems
CO5	Design information dashboard.

CO6	Apply visualization techniques find issue of Hardware.
TEXT BOOKS:	
1	Andy Kirk, “Data Visualization :A Hand book for Data Driven Design”, 2ndEdition ,Sage Publications, India, 2019.
2	Claus O . Wilke, “Fundamentals of DataVisualization”,1stEdition ,O’Reilly Media ,USA,2019.
REFERENCE BOOKS:	
1	Matthew O. Ward ,Georges Grinstein , Daniel Keim “Interactive Data Visualization: Foundations, Techniques ,and Applications”, CRC Press; 2nd Edition,2015
2	Stephen Few, "Now you see it: Simple Visualization Techniques for Quantitative Analysis", 1stEdition ,Analytics Press ,2009.
3	Stephen Few, "Information Dashboard Design :The Effective Visual Communication of Data",1st Edition, O'Reilly,2006.
4	BenFry,"Visualizingdata: Exploring and explaining data with the processing environment", 1stEdition, O'Reilly, 2013

P23CAE44	BIO INFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand nature and scope of computational biology and Bioinformatics
2	To understand Amino acids, Proteins
3	To do graph algorithms
4	To do clustering algorithms
5	To understand PAM probability matrix and log odds matrix

UNIT I	BIO INFORMATICS	9

introduction to - nature and scope of computational biology and Bioinformatics. Cells - prokaryotes and eukaryotes - DNA double helix - central dogma – RNA, Amino acids, Proteins - string representations. A glossary of Bioinformatics terms - file format for bio-molecular sequences, sequence alignment, phylogeny, gene finding, microarray analysis, homology and evolutionary relationships.

UNIT II	BASIC ALGORITHMS	9

Basic algorithms in Computational Biology - exhaustive search methods and their applications in Computational Biology - string matching algorithms. Motif finding - tandem repeats – concept of dynamic programming - graph algorithms - clustering algorithms.

UNIT III	SEQUENCE ALIGNMENT	9

Sequence alignment - pair-wise sequence alignment, Sequence similarity, identity, and homology. Global and local alignment, Dot plots for sequence comparison, Dynamic programming. Need of scoring schemes - penalizing gaps, scoring matrices for amino acid sequence alignment, PAM probability matrix and log odds matrix, BLOSUM.

UNIT IV	DOT	9

Dot-plot visualization, Needleman-Wunsch algorithm- effect of scoring schemes – e values - BLAST and FASTA, Smith – Waterman algorithm for local alignment. Multiple sequence alignment - sequence alignment using dynamic programming, N-dimensional dynamic programming. Tools for MSA - muscle and T-Coffee. Phylogenetic algorithms - evaluation of phylogenetic trees, significance.

UNITV	INTRODUCTION TO THE MAJOR RESOURCES	9

Introduction to the major resources - NCBI, EBI and ExPASy - nucleic acid sequence databases - GenBank, EMBL, DDBJ – Protein sequence databases - SWISS-PROT, TrEMBL, PIR_PSD - genome databases at NCBI, EBI, TIGR, SANGER – procedures to access these databases and to make use of the tools available.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Analysis the Sequence alignment
CO2	Analysis the effect of scoring schemes
CO3	Understand the procedures to access these databases and to make use of the tools available
CO4	Analysis the scoring matrices for amino acid sequence alignment
CO5	Understand the Multiple sequence alignment
CO6	Understand the nucleic acid sequence databases

TEXT BOOKS:	
1	Sushmita M and Tinku A, Data Mining: Multimedia, Soft Computing and Bioinformatics, Wiley-Interscience, ISBN: 9780471460541
2	Jeremy J. Ramsden, Bioinformatics: An Introduction, Springer, ISBN: 9789401570961.
REFERENCE BOOKS:	
1	Mount D, Bioinformatics: Sequence & Genome Analysis, 2nd Edition, Cold spring Harbor Press, ISBN: 978-087969712.
2	Dan Gusfield, Algorithms on Strings Trees and Sequences, 1st Edition, Cambridge University Press, ISBN: 0521585198.
3	Pevzner P A, Computational Molecular Biology: An Algorithmic Approach, MIT Press, Cambridge, MA, ISBN: ISBN: 9780262161978.
4	Jeremy J. Ramsden, Bioinformatics: An Introduction, Springer, ISBN: 9789401570961.

P23CAE45	ADHOC AND SENSOR NETWORK	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To learn about the issues and challenges in the design of wireless ad hoc networks.
2	To understand the working of MAC and Routing Protocols for ad hoc and sensor networks
3	To learn about the Transport Layer protocols and their QoS for ad hoc and sensor networks.
4	To understand various security issues in ad hoc and sensor networks and the corresponding solutions.
5	Analyze communication protocols and network topologies used in sensor networks.

UNIT I	MAC & ROUTING IN AD HOC NETWORKS	9

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols

UNIT II	TRANSPORT & QOS IN AD HOC NETWORKS	9

TCP‟s challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model

UNIT III	MAC & ROUTING IN WIRELESS SENSOR NETWORKS	9

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention- Based protocols – Schedule-Based protocols – IEEE 802.15.4 ZigBee – Topology Control – Routing Protocols

UNIT IV	TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS	9

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples

UNIT V	SECURITY IN AD HOC AND SENSOR NETWORKS	9

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Identify different issues in wireless ad hoc and sensor networks
CO2	To analyze protocols developed for ad hoc and sensor networks
CO3	To identify and understand security issues in ad hoc and sensor networks.

CO4	To identify Key Distribution and Management
CO5	To identify Routing Protocols
CO6	To identify Network Layer QoS solutions
TEXT BOOKS:	
1	C.Siva Ram Murthy and B.S.Manoj, ―Ad Hoc Wireless Networks – Architectures and 2 Protocols‖, Pearson Education, 2006.
2	Holger Karl, Andreas Willing, ―Protocols and Architectures for Wireless Sensor Networks‖, John Wiley & Sons, Inc., 2005.
REFERENCE BOOKS:	
1	Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, ―Ad Hoc Mobile Wireless Networks‖, Auerbach Publications, 2008.
2	Carlos De Morais Cordeiro, Dharma Prakash Agrawal, ―Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition)‖, World Scientific Publishing, 2011.
3	C.Siva Ram Murthy and B.S.Manoj, ―Ad Hoc Wireless Networks – Architectures and 2 Protocols‖, Pearson Education, 2006.
4	Holger Karl, Andreas Willing, ―Protocols and Architectures for Wireless Sensor Networks‖, John Wiley & Sons, Inc., 2005.

P23CAP28	CLOUD COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	Be exposed to tool kits for cloud and Hadoop environment.
2	Be familiar with migration of Virtual Machines from one node to another
3	Learn to use Hadoop Distributed File System (HDFS) to setup single and multi–node clusters
4	Be exposed to tool kits for cloud and Hadoop environment.
5	To do install storage controller and interact with it.

LIST OF EXPERIMENTS

1	Demonstrate the procedure for creating AWS instance and install compiler and run program
2	Create S3 bucket and upload a file using AWS S3 bucket.
3	Demonstrate the procedure for creating AWS RDS instance and execute sample SQL statement
4	Host a web application in AWS instance
5	Develop and deploy an application using Microsoft Azure
6	Create a Customer Relationship Management System (CRM) using salesforce.com portal.
7	Design scheduler and personal information management using zohoworkerly
8	Create and use a repository using github
9	Create visually appealing data visualizations and insightful dashboards using Zoho
10	Create a blog to show the profile of our MCA department
11	Demonstrate the steps for web application deployment using azure devops
12	Create a web application and deployment in 000webhost cloud platform

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1	Embedded Linux	
2	Desktop Linux	
3	Embedded Windows	
4	Desktop Windows	
5	Roll your own or in-house	
6	UNIX	
7	Embedded Linux	

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Show an ability to upload/download sensor data on cloud and server.
CO2	Work with serverless architectures and explore services like AWS Lambda, Azure Functions, or Google Cloud Functions..
CO3	use and investigate various cloud computing services
CO4	utilize productivity software, create and develop cloud apps.
CO5	install a program on cloud platform

P23CAP29	DATA SCIENCE LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1	To understand the basic Statistical and Probability measures for data science.
2	To learn descriptive analytics on the benchmark data sets.
3	To apply correlation and regression analytics on standard data sets.
4	To present and interpret data using visualization packages in Python.
5	To do Classification model.

LIST OF EXPERIMENTS

1	R as calculator application
2	Descriptive statistics in R
3	Reading and writing different types of dataset
4	Visualizations
5	Correlation and Covariance
6	Regression model
7	Multiple regression model
8	Regression model for prediction
9	Classification model
10	Clustering mode

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1	Intel i7 processor with 25GHz clock frequency, 8GB RAM, 500GB Hard Disk.	
2	Windows10, Ubuntu 16.04	
3	Python 36.5, R-Language, OpenCV, C, C++, JAVA.	
4	Oracle 1210.20 with analytics.	
5	High Speed Internet, Projector, White Board, Intercom	

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Understand and apply R programming concepts for data manipulation, analysis, and visualization.
CO2	Import, clean, and preprocess datasets using R and RStudio for efficient data analysis.
CO3	Understand and apply R programming concepts for data manipulation, analysis, and visualization.
CO4	Analyze the Correlation and Covariance.
CO5	Understand the Visualizations and formats
CO6	Understand the basic Statistical and Probability measures for data science.

LIST OF OPEN ELECTIVE FOR PG PROGRAMMES

SEMESTER III

P23CAO1	INTEGRATED WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

1	To do IWRM within the broader context of development
2	To Economic view of water issues: economic characteristics of water good and services
3	Understanding UN law on non–navigable uses of international water courses
4	To do Global burden of Diseases
5	To identify the current water pricing policy

UNITI	CONTEXT FOR IWRM	9

Water as a global issue: key challenges–Definition of IWRM within the broader context of development – Key elements of IWRM – Principles – Paradigm shift in water management – Complexity of the IWRM process – UN World Water Assessment–SDGs.

UNIT II	WATER ECONOMICS	9

Economic view of water issues: economic characteristics of water good and services – Non–market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP COURSE OBJECTIVES– PPP models– PPP processes– PPP experiences through case studies.

UNIT III	LEGAL AND REGULATORY SETTINGS	9

Basic notion of law and governance: principles of international and national law in the area of water management – Understanding UN law on non–navigable uses of international water courses–Internationallawforgroundwatermanagement–WorldWaterForums– GlobalWaterPartnerships–DevelopmentofIWRMin line with legal and regulatory framework.

UNIT IV	WATER AND HEALTH WITH IN THE IWRM CONTEXT	9

Links between water and health: options to include water management interventions for health –Health protection and promotion in the context of IWRM – Global burden of Diseases – Health impact assessment of water resources development projects– Case studies.

UNIT V	AGRICULTURE IN THE CONCEPT OF IWRM	9

Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print – Virtual water trade for achieving global water and food security — Irrigation efficiencies– irrigation methods – current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Describe the context and principles of IWRM; Compare the conventional and integrated Ways of water management.
CO2	Select the best economic option among the alternatives; illustrate the pro sand cons of PPP Through case studies.
CO3	Apply law and governance in the context of IWRM.
CO4	Discuss the link ages between water–health; develop a HIA framework.
CO5	Analyze how the virtual water concept pave way to alternate policy options.
CO6	Analyze Health impact assessment of water resources development projects.
TEXT BOOKS:	
1	TechnicalAdvisoryCommittee– EffectiveWaterGovernance".TechnicalAdvisoryCommitteeBackgroundpaperNo:7.Gl obalwaterpartnership–Stockholm–Sweden– 2003
2	Mollinga .P. etal " Integrated Water Resources Management"– Water in South Asia Volume I– SagePublications–2006.
REFERENCES	
1	Cech Thomas V.– Principles of water resources: history– development– management and policy. John Wileyand SonsInc.–NewYork.2003
2	Mollinga .P. etal " Integrated Water Resources Management"– Water in South Asia Volume I–SagePublications–2006
3	TechnicalAdvisoryCommittee–IntegratedWaterResourcesmanagement– TechnicalAdvisoryCommitteeBackgroundPaperNo:4Globalwaterpartnership–Stockholm– Sweden.2002
4	TechnicalAdvisoryCommittee– Dublinprinciplesforwaterasreflectedincomparativeassessmentofinstitutionalandlegala rrangementsforIntegratedWaterResourcesManagement– TechnicalAdvisoryCommitteeBackgroundpaperNo:3Globalwaterpartnership– Stockholm–Sweden.1999.

P23CAO2	WATER– SANITATION AND HEALTH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1	To analyze Sanitation And Hygiene
2	To do Sect oral Allocation
3	To Democratization of Reforms and Initiatives.
4	To Millennium Development Goal
5	To Factors Contribute to water.

UNITI	FUNDAMENTALSWASH	9

Meanings and Definition: Safe Water– Health– Nexus: Water– Sanitation – Health and Hygiene –Equity issues–Water security – Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management(IWRM)–Need and Importance of WASH

UNITII	MANAGERIAL IMPLICATIONSANDIMPACT	9

Third World Scenario–Poor and Multidimensional Deprivation Health Burden in Developing Scenario– Factors contribute to water– sanitation and hygiene related diseases– Social: Social Stratification and Literacy Demography: Population and Migration–Fertility– Mortality–Environment: Water Borne–Water Washed and Water Based Diseases –Economic: Wage Water and Health Budgeting–Psychological: Non–compliance– Disease Relapse– Political: Political Will.

UNITIII	CHALLENGES INMANAGEMENTANDDEVELOPMENT	9

Common Challenges in WASH – Bureaucracy and Users– Water Utilities –Sect oral Allocation:– Infrastructure– Service Delivery: Health services: Macro and Micro– level: Community and Gender Issues–Equity Issues–Paradigm Shift: Democratization of Reforms and Initiatives.

UNITIV	GOVERNANCE	9

Public health–CommunityHealthAssessmentandImprovementPlanning(CHA/CHIP)– Infrastructure and Investment son Water–(WASH)–Cost Benefit Analysis– Institutional Intervention–Public Private Partnership–Policy Directives–Social Insurance– Political Wills Participatory Governance.

UNITV	INITIATIVES	9

ManagementvsDevelopment–AcceleratingDevelopment–DevelopmentIndicators– Inclusive Development–Global and Local– Millennium Development Goal (MDG) and Targets – Five Year Plans –Implementation–Capacity Building–Case studies on WASH.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Capture to fundamental concepts and terms which are to be applied and understood All through the study.
CO2	Comprehendthevariousfactorsaffectingwatersanitationandhealththroughthelens of third world scenario.
CO3	Critically analyse and articulate he underlying common challenges in water–sanitation and health.
CO4	Acquire knowledge on the attributes of governance and its say on water sanitation and health.
CO5	Gainanoverarchinginsightintotheaspectsofsustainableresourcemanagementin The absence of a clear level playing field in the developmental aspects.
CO6	Analyze the Capacity of Building.

TEXT BOOKS:	
1	Inter sectoral Water Allocation Planning and Management– 2000– World Bank Publisherswww.Amazon.com
2	ThirdWorldNetwork.org(www.twn.org).

REFERENCES	
1	Bonitha R.– Beaglehole R.– Kjellstorm– 2006– "Basic Epidemiology"– 2nd Edition– World Health Organization.
2	Van Note Chism– N. and Bickford– D. J. (2002)– Improving the environment for learning: An expanded agenda. New Directions for Teaching and Learning– 2002: 91–98.doi:10.1002/tl.83ImprovingtheEnvironmentfor learning: An Expanded Agenda
3	National Research Council. *Global Issues in Water–Sanitation– and Health: Workshop Summary***.** Washington–DC: The NationalAcademiesPress–2009.
4	Sen– Amartya 1997. On Economic Inequality. Enlarged edition– with annex by James Foster and Amartya Sen–Oxford:ClaredonPress–1997.

P23CAO3	PRINCIPLESOFSUSTAINABLEDEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	economic and social dimensions of sustainability.
2	business charter for sustainable development.
3	Demographic dynamics of sustainability.
4	Sustainable Development Goals and Linkage to Sustainable Consumption and Production.
5	Approaches to measuring and analyzing sustainability.

UNITI	SUSTAINABILITY ANDDEVELOPMENTCHALLEGES	9

Definition of sustainability – environmental– economical and social dimensions of sustainability – sustainable development models – strong and weak sustainability – defining development– millennium development goals – mindsets for sustainability: earthly– analytical– precautionary– action and collaborative– syndromes of global change: utilisation syndromes– development syndromes– and sink syndromes – core problems and cross cutting Issues of the 21 century – global– regional and local environmental issues – social insecurity – resource degradation –climate change – desertification.

UNIT II	PRINCIPLES AND FRAME WORK	9

History and emergence of the concept of sustainable development – our common future – Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step– peoples earth charter – business charter for sustainable development –UN Global Compact – Role of civil society– business and government – United Nations' 2030 Agenda for sustainable development – 17 sustainable development goals and targets– indicators and intervention areas.

UNIT III	SUSTAINABLE DEVELOPMENT AND WELLBEING	9

The Unjust World and inequities – Quality of Life – Poverty– Population and Pollution – Combating Poverty – Demographic dynamics of sustainability – Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework– Health– Education and Empowerment of Women– Children– Youth– Indigenous People– Non–Governmental Organizations– Local Authorities and Industry for Prevention– Precaution – Preservation and Public participation.

UNIT IV	SUSTAINABLE SOCIO–ECONOMIC SYSTEMS	10

Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital– Agriculture– Forests– Fisheries – Food security and nutrition and sustainable agriculture– Water and sanitation – Biodiversity conservation and Ecosystem integrity – Ecotourism – Sustainable Cities – Sustainable Habitats– Green Buildings – Sustainable Transportation — Sustainable Mining – Sustainable Energy– Climate Change – Mitigation and Adaptation – Safeguarding Marine Resources – Financial Resources and Mechanisms.

UNIT V	ASSESSING PROGRESS AND WAY FORWARD	8
Nature of sustainable development strategies and current practice– Sustainability in global– regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP– Ecological Footprint– Human Development Index– Human Development Report – National initiatives for Sustainable Development – Hurdles to Sustainability – Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course the students would be able to		
CO1	Explain and evaluate current challenges to sustainability– including modern world social– environmental– and economic structures and crises.	
CO2	Identify and critically analyze the social environmental– and economic dimensions of sustainability in terms of UN Sustainable development goals	
CO3	Develop a fair understanding of the social– economic and ecological linkage of Human well being– production and consumption	
CO4	Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.	
CO5	Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.	
CO6	Science and Technology for sustainable development.	
TEXT BOOKS:		
1	Nolberto Munier– Introduction to Sustainability: Road to a Better Future– Springer– 2006	
2	Barry Dalal Clayton and Stephen Bass– Sustainable Development Strategies– a resource book"– Earthscan Publications Ltd– London– 2002	
REFERENCES		
1	Tom Theis and Jonathan Tomkin– Sustainability: A Comprehensive Foundation– RiceUniversity– Houston– Texas– 2012	
2	A guide to SDG interactions:from science to implementation– International Council forScience– Paris–2017.	
3	Karel Mulder– Sustainable Development for Engineers – A Handbook and Resource Guide–Rouledge Taylor and Francis– 2017.	
4	New Global Frontier – Urbanization– Poverty and Environmentin the 21st Century – *George Martine–Gordon McGranahan–Mark Montgomery and Rogelio Fernández–Castilla*– IIED andUNFPA– Earthscan– UK– 2008.	

P23CAO4	ENVIRONMENTAL IMPACT ASSESSMENT	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES

1	Development of Environmental Impact Assessment.
2	Mathematical modelling for impact prediction.
3	communities in transition.
4	Environmental management plan.
5	Documentation of EIA findings.

UNIT I	INTRODUCTION	9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance– EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process– screening – scoping – terms of reference in EIA– setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA– EIA consultant accreditation.

UNIT II	IMPACT INDENTIFICATION AND PREDICTION	10

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment.

UNIT III	SOCIO–ECONOMIC IMPACT ASSESSMENT	8

Socio–economic impact assessment – relationship between social impacts and change in community and institutional arrangements. factors and methodologies– individual and family level impacts. communities in transition–rehabilitation.

UNIT IV	EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN	9

Environmental management plan – preparation– implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.

UNIT V	CASE STUDIES	9

Mining– power plants– cement plants– highways– petroleum refining industry– storage & handling of hazardous chemicals– common hazardous waste facilities– CETPs– CMSWMF– building and construction projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Understand need for environmental clearance– its legal procedure– need of EIA– its types– stakeholders and their roles.
CO2	Understand various impact identification methodologies– prediction techniques and model of impacts on various environments.
CO3	Understand relationship between social impacts and change in community due to development activities and rehabilitation methods
CO4	Document the EIA findings and prepare environmental management and monitoring plan
CO5	Identify– predict and assess impacts of similar projects based on case studies
CO6	common hazardous waste facilities
TEXT BOOKS:	
1	World Bank –Source book on EIA –1999
2	Sam Mannan– Lees' Loss Prevention in the Process Industries– Hazard Identification Assessment and Control– 4th Edition– Butterworth Heineman– 2012
REFERENCE:	
1	EIA Notification 2006 including recent amendments– by Ministry of Environment– Forest and Climate Change– Government of India.
2	Sectoral Guidelines under EIA Notification by Ministry of Environment– Forest and Climate Change– Government of India.
3	Canter– L.W.– Environmental Impact Assessment– McGraw Hill– New York. 1996
4	Lawrence– D.P.– Environmental Impact Assessment – Practical solutions to recurrent problems– Wiley–Interscience– New Jersey. 2003

P23CAO5	VIBRATION AND NOISE CONTROL STRATEGIES	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES

1	To appreciate the basic concepts of vibration in damped and un damped systems
2	To appreciate the basic concepts of noise– its effect on hearing and related terminology
3	To use the instruments for measuring and analyzing the vibration levels in a body
4	To use the instruments for measuring and analyzing the noise levels in a system
5	To learn the standards of vibration and noise levels and their control techniques

UNIT– I	BASICS OF VIBRATION	9

Introduction – Sources and causes of Vibration–Mathematical Models – Displacement– velocity and Acceleration – Classification of vibration: free and forced vibration– un damped and damped vibration– linear and non–linear vibration – Single Degree Freedom Systems – Vibration isolation – Determination of natural frequencies.

UNIT– II	BASICS OF NOISE	9

Introduction – Anatomy of human ear – Mechanism of hearing – Amplitude– frequency– wavelength and sound pressure level – Relationship between sound power– sound intensity and sound pressure level – Addition– subtraction and averaging decibel levels – sound spectra –Types of sound fields – Octave band analysis – Loudness.

UNIT– III	INSTRUMENTATION FOR VIBRATION MEASUREMENT	9

Experimental Methods in Vibration Analysis.– Vibration Measuring Instruments – Selection of Sensors – Accelerometer Mountings – Vibration Exciters – Mechanical– Hydraulic– Electromagnetic and Electrodynamics – Frequency Measuring Instruments –. System Identification from Frequency Response –Testing for resonance and mode shapes

UNIT– IV	INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS	9

Microphones – Weighting networks – Sound Level meters– its classes and calibration – Noise measurements using sound level meters – Data Loggers – Sound exposure meters – Recording of noise – Spectrum analyzer – Intensity meters – Energy density sensors – Sound source localization.

UNIT– V	METHODS OF VIBRATION CONTROL– SOURCES OF NOISE AND ITS CONTROL	9

Specification of Vibration Limits – Vibration severity standards – Vibration as condition Monitoring Tool – Case Studies – Vibration Isolation methods – Dynamic Vibration Absorber – Need for Balancing – Static and Dynamic Balancing machines – Field balancing – Major sources of noise – Noise survey techniques – Measurement technique for vehicular noise – Road vehicles Noise standard – Noise due to construction equipment and domestic appliances – Industrial noise sources and its strategies – Noise control at the source – Noise control along the path – Acoustic Barriers – Noise control at the receiver — Sound transmission through barriers – Noise reductions Vs Transmission loss – Enclosures

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	apply the basic concepts of vibration in damped and un damped systems
CO2	apply the basic concepts of noise and to understand its effects on systems
CO3	select the instruments required for vibration measurement and its analysis
CO4	select the instruments required for noise measurement and its analysis.
CO5	recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies
CO6	Apply Frequency Measuring Instruments
TEXT BOOKS:	
1	G.K. Grover– "Mechanical Vibrations"– Nem Chand and Bros.–Roorkee– 2014
2	A.G. Ambekar– "Mechanical Vibrations and Noise Engineering"– PHI Learning Pvt. Ltd.– 2014
REFERENCES	
1	Singiresu S. Rao– "Mechanical Vibrations"– Pearson Education Incorporated– 2017.
2	Graham Kelly. Sand Shashidhar K. Kudari– "Mechanical Vibrations"– Tata McGraw –HillPublishing Com. Ltd.– 2007.
3	Ramamurti. V– "Mechanical Vibration Practice with Basic Theory"– Narosa Publishing House–2000.
4	William T. Thomson– "Theory of Vibration with Applications"– Taylor & Francis– 2003

P23CAO6	ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES

1	To learn the present energy scenario and the need for energy conservation.
2	To understand the different measures for energy conservation in utilities.
3	Acquaint students with principle theories– materials– and construction techniques to create energy efficient buildings.
4	To identify the energy demand and bridge the gap with suitable technology for sustainable habitat
5	To get familiar with the energy technology– current status of research and find the ways to optimize a system as per the user requirement

UNIT I	ENERGY SCENARIO	9

Primary energy resources – Sectorial energy consumption (domestic– industrial and other sectors)– Energy pricing– Energy conservation and its importance– Energy Conservation Act–2001 and its features – Energy star rating.

UNIT II	HEATING– VENTILLATION & AIR CONDITIONING	9

Basics of Refrigeration and Air Conditioning – COP / EER / SEC Evaluation – SPV system design& optimization for Solar Refrigeration.

UNIT III	LIGHTING– COMPUTER– TV	9

Specification of Luminaries – Types – Efficacy – Selection & Application – Time Sensors – Occupancy Sensors – Energy conservation measures in computer – Television – Electronic devices.

UNIT IV	ENERGY EFFICIENT BUILDINGS	9

Conventional versus Energy efficient buildings – Landscape design – Envelope heat loss and heat gain – Passive cooling and heating – Renewable sources integration.

UNIT V	ENERGY STORAGE TECHNOLOGIES	9

Necessity & types of energy storage – Thermal energy storage – Battery energy storage– charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues– Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Understand technical aspects of energy conservation scenario.
CO2	Energy audit in any type for domestic buildings and suggest the conservation measures.
CO3	Perform building load estimates and design the energy efficient landscape system.
CO4	Gain knowledge to utilize an appliance/device sustainably.
CO5	Understand the status and current technological advancement in energy storage field.
CO6	Understand the Hydrogen energy storage & Super capacitors
TEXT BOOKS:	
1	Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)
2	Ibrahim Dincer and Mark A. Rosen– Thermal Energy Storage Systems and Applications– John Wiley & Sons 2002
REFERENCES	
1	Yogi Goswami– Frank Kreith– Energy Efficiency and Renewable energy Handbook– CRC Press– 2016.
2	ASHRAE Handbook 2020 – HVAC Systems & Equipment
3	Paolo Bertoldi– Andrea Ricci– Anibal de Almeida– Energy Efficiency in Household Appliances and Lighting– Conference proceedings– Springer– 2001
4	David A. Bainbridge– Ken Haggard– Kenneth L. Haggard– Passive Solar Architecture: Heating– Cooling– Ventilation– Daylighting– and More Using Natural Flows– Chelsea Green Publishing– 2011

P23CAO7	ADDITIVE MANUFACTURING	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES

1	To understand Rapid Manufacturing.
2	Part Orientation and Support Structure Generation.
3	Stereo lithography Apparatus.
4	Applications and Limitations. Sheet Lamination Process.
5	Development of surgical tools Food Printing.

UNIT I	INTRODUCTION	9

Need – Development – Rapid Prototyping Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain– Classification – Benefits.

UNIT II	DESIGN FOR ADDITIVE MANUFACTURING	9

CAD Model Preparation – Part Orientation and Support Structure Generation –Model Slicing – Tool Path Generation Customized Design and Fabrication – Case Studies

UNIT III	VAT POLYMERIZATION	9

Stereo lithography Apparatus (SLA)– Materials –Process –Advantages Limitations– Applications. Digital Light Processing (DLP) – Materials – Process – Advantages – Applications. Multi Jet Modeling (MJM) – Principles – Process – Materials – Advantages and Limitations.

UNIT IV	MATERIAL EXTRUSION AND SHEET LAMINATION	9

Fused Deposition Modeling (FDM)– Process–Materials – Applications and Limitations. Sheet Lamination Process: Laminated Object Manufacturing (LOM)– Basic Principle– Mechanism: Gluing or Adhesive Bonding – Thermal Bonding– Materials– Application and Limitation – Bio–Additive Manufacturing Computer Aided Tissue Engineering (CATE) – Case studies

UNIT V	CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES	9

Education and training – Automobile– pattern and mould – tooling – Building Printing–Bio Printing – medical implants –development of surgical tools Food Printing –Printing Electronics. Business Opportunities and Future Directions – Intellectual Property

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Understand pattern and mould
CO2	Business Opportunities and Future Directions
CO3	Additive Manufacturing Computer Aided Tissue Engineering
CO4	Laminated Object Manufacturing
CO5	Part Orientation and Support Structure Generation
CO6	Advantages and Limitations.

TEXT BOOKS:	
1	Chua C.K.– Leong K.F.– and Lim C.S.– "Rapid prototyping: Principles and applications"– Thirdedition– World Scientific Publishers– 2010.
2	Amit Bandyo padhyay and Susmita Bose– "Additive Manufacturing"– 1st Edition– CRC Press.–United States– 2015– ISBN–13: 978–1482223590
REFERENCES	
1	Andreas Gephardt and Jan–Steffen Hotter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing"– Hanser publications– United States– 2015– ISBN: 978–1– 56990–582–1
2	Ian Gibson– David W. Rosen and Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing"– 2nd edition– Springer.– United States– 2015– ISBN13: 978–1493921126.
3	Amit Bandyo padhyay and Susmita Bose– "Additive Manufacturing"– 1st Edition– CRC Press.–United States– 2015– ISBN–13: 978–1482223590
4	Andreas Gebhardt– "Understanding Additive Manufacturing: Rapid Prototyping– RapidManufacturing"– Hanser Gardner Publication– Cincinnati.– Ohio– 2011– ISBN :9783446425521

P23CAO8	ELECTRIC VEHICLE TECHNOLOGY	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES

1	social and environmental importance of hybrid and electric vehicles
2	traction motor characteristics
3	Find electrochemical reactions
4	Battery modelling and equivalent circuit
5	Thermal Management of the PEM fuel cell

UNIT I	NEED FOR ELECTRIC VEHICLES	9

History and need for electric and hybrid vehicles– social and environmental importance of hybrid and electric vehicles– impact of modern drive–trains on energy supplies– comparison of diesel– petrol– electric and hybrid vehicles– limitations– technical challenges.

UNIT II	ELECTRIC VEHICLE ARCHITECHTURE	9

Electric vehicle types– layout and power delivery– performance – traction motor characteristics– tractive effort– transmission requirements– vehicle performance– energy consumption– Concepts of hybrid electric drive train– architecture of series and parallel hybrid electric drive train– merits and demerits– mild and full hybrids– plug–in hybrid electric vehicles and range extended hybrid electric vehicles– Fuel cell vehicles.

UNIT III	ENERGY STORAGE	9

Batteries – types – lead acid batteries– nickel based batteries– and lithium based batteries– electrochemical reactions– thermodynamic voltage– specific energy– specific power– energy efficiency– Battery modelling and equivalent circuit– battery charging and types– battery cooling– Ultra–capacitors– Flywheel technology– Hydrogen fuel cell– Thermal Management of the PEM fuel cell

UNIT IV	ELECTRIC DRIVES AND CONTROL	9

Types of electric motors – working principle of AC and DC motors– advantages and limitations– DC motor drives and control– Induction motor drives and control– PMSM and brushless DC motor – drives and control – AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers.

UNIT V	DESIGN OF ELECTRIC VEHICLES	9

Materials and types of production– Chassis skate board design– motor sizing– power pack sizing– component matching– Ideal gear box – Gear ratio– torque–speed characteristics– Dynamic equationof vehicle motion– Maximum tractive effort – Power train tractive effort Acceleration performance– rated vehicle velocity – maximum grad ability– Brake performance– Electronic control system– safety and challenges in electric vehicles. Case study of Nissan leaf– Toyota Prius– tesla model 3– and Renault Zoe cars.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Dynamic equationof vehicle motion
CO2	Maximum tractive effort
CO3	hybrid electric vehicles and range extended hybrid electric vehicles
CO4	Concepts of hybrid electric drive train
CO5	Flywheel technology
CO6	Acceleration performance
TEXT BOOKS:	
1	P Joshi · 2022 · Cited by 1 — This slide deck was developed for and presented at an Energy Fundamentals Course hosted by the Bangladesh University of Engineering
2	R Braking — **Electric vehicles** (**EVs**) use electricity as their primary fuel or to improve the efficiency of conventional vehicle designs
1	Iqbal Hussein– Electric and Hybrid Vehicles: Design Fundamentals– 2nd edition CRC Press–2011
2	Mehrdad Ehsani– Yimi Gao– Sebastian E. Gay– Ali Emadi– Modern Electric– Hybrid Electric andFuel Cell Vehicles: Fundamentals– Theory and Design– CRC Press– 2004
3	James Larminie– John Lowry– Electric Vehicle Technology Explained – Wiley– 2003
4	Ehsani– M– "Modern Electric– Hybrid Electric and Fuel Cell Vehicles: Fundamentals– Theory andDesign"– CRC Press– 2005

P23CAO9	NEW PRODUCT DEVELOPMENT	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1	Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2	Identifying opportunity and planning for new product design and development.
3	Conducting customer need analysis; and setting product specification for new product design and development.
4	Generating– selecting– and testing the concepts for new product design and development.
5	Appling the principles of Industrial design and prototype for new product design and development.

UNIT I	INTRODUCTION TO PRODUCTDESIGN & DEVELOPMENT	9

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development – Duration and Cost of Product Development – The Challenges of Product Development – The Product Development Process – Concept Development: The Front–End Process – Adapting the Generic Product Development Process – Product Development Process Flows – Product Development Organizations.

UNIT II	OPPORTUNITY DENTIFICATION & PRODUCT PLANNING	9

Opportunity Identification: Definition – Types of Opportunities – Tournament Structure of Opportunity Identification – Effective Opportunity Tournaments – Opportunity Identification Process – Product Planning: Four types of Product Development Projects – The Process of Product Planning.

UNIT III	IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS	9

Identifying Customer Needs: The Importance of Latent Needs – The Process of Identifying Customer Needs. Product Specifications: Definition – Time of Specifications Establishment – Establishing Target Specifications – Setting the Final Specifications.

UNIT IV	CONCEPT GENERATION– SELECTION & TESTING	9

Concept Generation: Activity of Concept Generation – Structured Approach – Five step method of Concept Generation. Concept Selection: Methodology – Concept Screening and Concepts Scoring. Concept testing: Seven Step activities of concept testing.

UNIT V	INDUSTRIAL DESIGN & PROTOTYPING	9

Industrial Design: Need and Impact–Industrial Design Process. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Apply the principles of generic development process; and understand the organization structure for new product design and development.
CO2	Identify opportunity and plan for new product design and development
CO3	Conduct customer need analysis; and set product specification for new product design and development.
CO4	Generate– select– and test the concepts for new product design and development.
CO5	Apply the principles of Industrial design and prototype for design and develop new products.
CO6	Apply Seven Step activities of concept testing.
TEXT BOOKS:	
1	Ulrich K.T.– Eppinger S. D. and Anita Goyal– "Product Design and Development "McGraw–Hill Education; 7 edition– 2020.
2	Jamnia– A.– Introduction to Product Design and Development for Engineers– CRC Press–2018.
REFERENCES:	
1	Belz A.– 36–Hour Course: "Product Development" McGraw–Hill– 2010.
2	Rosenthal S.–"Effective Product Design and Development"– Business One Orwin– Homewood– 1992–ISBN1–55623–603–4
3	Pugh.S–"Total Design Integrated Methods for Successful Product Engineering"– Addison Wesley Publishing–1991–ISBN0–202–41639–5.
4	Chitale– A. K. and Gupta– R. C.– Product Design and Manufacturing– PHI Learning– 2013

P23CAO10	SUSTAINABLE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1	To provide students with fundamental knowledge of the notion of corporate sustainability.
2	To determine how organizations impacts on the environment and socio.
3	the relationship between social and environmental performance and competitiveness
4	the approaches and methods
5	theoretical pillarsin sustainability management

UNIT I	MANAGEMENT OF SUSTAINABILITY	9

Management of sustainability –rationale and political trends: An introduction to sustainability management– International and European policies on sustainable development– theoretical pillarsin sustainability management studies.

UNIT II	CORPORATE SUSTAINABILITY AND RESPONSIBILITY	9

Corporate sustainability parameter r– corporate sustainability institutional framework – integration of sustainability into strategic planning and regular business practices – fundamentals of stakeholder engagement

UNIT III	SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES	9

Corporate sustainability management and competitiveness: Sustainability–oriented corporate strategies– markets and competitiveness– Green Management between theory and practice– Sustainable Consumption and Green Marketing strategies– Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV	SUSTAINABILITY AND INNOVATION	9

Socio–technical transitions and sustainability– Sustainable entrepreneurship– Sustainable pioneers in green market niches– Smart communities and smart specializations.

UNIT V	SUSTAINABLE MANAGEMENT OF RESOURCES– COMMODITIES AND COMMONS	9

Energy management– Water management– Waste management– Wild Life Conservation– Emerging trends in sustainable management– Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	An understanding of sustainability management as an approach to aid in evaluating.
CO2	An understanding of corporate sustainability and responsible Business Practices
CO3	Knowledge and skills to understand– to measure and interpret sustainability performances.
CO4	Knowledge of innovative practices in sustainable business and community management

CO5	Deep understanding of sustainable management of resources and commodities
CO6	Emergingtrends in sustainable management

TEXT BOOKS:	
1	Peter Rogers– An Introduction to Sustainable Development– 2006
2	**Sustainable management** can be defined as the combination of factors like; being long-term. According to the Edelman Trust Barometer 2022
REFERENCE:	
1	Daddi– T.– Iraldo– F.– Testa– Environmental Certification for Organizations and Products:Management– 2015.
2	Christian N. Madu– Handbook of Sustainability Management 2012
3	Petra Molthan–Hill– The Business Student's Guide to Sustainable Management: Principlesand Practice– 2014
4	Margaret Robertson– Sustainability Principles and Practice– 2014

P23CAO11	MICRO AND SMALL BUSINESS MANAGEMENT	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES

1	To familiarize students with the theory and practice of small business management.
2	To learn the legal issues faced by small business and how they impact operations.
3	To entrepreneurship and small business
4	To barriers and triggers to new venture creation
5	Applying new venture screening process to the early stage small firm Role planning in small business

UNIT I	INTRODUCTION TO SMALL BUSINESS	9

Creation– Innovation– entrepreneurship and small business – Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship –evolution of entrepreneurship –Types of Entrepreneurship – social– civic– corporate – Business life cycle – barriers and triggers to new venture creation – process to assist start ups – small business and family business.

UNIT II	SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN	9

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III	BUILDING THE RIGHT TEAM AND MARKETING STRATEGY	9

Management and Leadership – employee assessments – Tuckman's stages of group development – The entrepreneurial process model – Delegation and team building – Comparison of HR management in small and large firms – Importance of coaching and how to apply a coaching model. Marketing within the small business – success strategies for small business marketing – customer delight and business generating systems– – market research– – assessing market performance– sales management and strategy – the marketing mix and marketing strategy.

UNIT IV	FINANCING SMALL BUSINESS	9

Main sources of entrepreneurial capital; Nature of 'bootstrap' financing – Difference between cash and profit – Nature of bank financing and equity financing – Funding–equity gap for small firms. Importance of working capital cycle – Calculation of break–even point – Power of gross profit margin– Pricing for profit – Credit policy issues and relating these to cash flow management and profitability

UNIT V	VALUING SMALL BUSINESS AND CRISIS MANAGEMENT	9

Causes of small business failure – Danger signals of impending trouble – Characteristics of poorly performing firms – Turnaround strategies – Concept of business valuation – Different valuation measurements – Nature of goodwill and how to measure it – Advantages and disadvantages of buying an established small firm – Process of preparing a business for sale.

TOTAL: 45 PERIOD

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Familiarize the students with the concept of small business
CO2	In depth knowledge on small business opportunities and challenges
CO3	Ability to devise plans for small business by building the right skills and marketing strategies
CO4	Identify the funding source for small start ups
CO5	Business evaluation for buying and selling of small firms
CO6	Advantages and disadvantages of buying an established small firm
TEXT BOOKS:	
1	HA Meressa · 2020 · Cited by 37 — The purpose of this study was to examine **micro and small** scale **enterprises**' growth determinants operating in Benishangul
2	Banujam .K.V. (1998), Poverty Alleviation through Rural Industrialisation Kurukshetra, Indian Journal of Rural Development, Vol. 33 Oct.1, pp. 51-53
REFERENCE:	
1	Hankinson–A.(2000). "The key factors in the profile of small firm owner–managers that influence business performance. The South Coast Small Firms Survey– 1997–2000." Industrial and Commercial Training 32(3):94–98.
2	Parker–R.(2000). "Small is not necessarily beautiful: An evaluation of policy support for small and medium–sized enterprise in Australia." Australian Journal of Political Science 35(2):239–253
3	Journal articles on SME's.
4	Berna. (2001), Entrepreneurship in Madras state, Yojana, April 30, Vol. 35, No. 7, pp. 6-7.

P23CAO12	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

1	To understand intellectual property rights and its valuation.
2	To Developments new in IPR
3	To Dole Act and Issues of Academic Entrepreneurship.
4	To Patent Information and databases
5	To Real Option Model in Strategic

UNIT I	INTRODUCTION	9

Intellectual property rights – Introduction– Basic concepts– Patents– Copyrights– Trademarks– Trade Secrets– Geographic Indicators; Nature of Intellectual Property– Technological Research– Inventions and Innovations– History – the way from WTO to WIPO– TRIPS.

UNIT II	PROCESS	9

New Developments in IPR– Procedure for grant of Patents– TM– GIs– Patenting under Patent Cooperation Treaty– Administration of Patent system in India– Patenting in foreign countries.

UNIT III	STATUTES	9

International Treaties and conventions on IPRs– The TRIPs Agreement– PCT Agreement– The Patent Act of India– Patent Amendment Act (2005)– Design Act– Trademark Act– Geographical Indication Act– Bayh– Dole Act and Issues of Academic Entrepreneurship.

UNIT IV	STRATEGIES IN INTELLECTUAL PROPERTY	9

Strategies for investing in R&D– Patent Information and databases– IPR strength in India– Traditional Knowledge– Case studies.

UNIT V	MODELS	9

The technologies Know–how– concept of ownership– Significance of IP in Value Creation– IP Valuation and IP Valuation Models– Application of Real Option Model in Strategic Decision Making–Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1	Understanding of intellectual property and appreciation of the need to protect it
CO2	Awareness about the process of patenting
CO3	Understanding of the statutes related to IPR
CO4	Ability to apply strategies to protect intellectual property
CO5	Ability to apply models for making strategic decisions related to IPR
CO6	IP Valuation and IP Valuation Models

TEXT BOOKS:	
1	WIPO Intellectual Property Hand book.
2	Intellectual Property rights and copyrights–EssEssPublications.
REFERENCES	
1	V. Sople Vinod– Managing Intellectual Property by (Prentice hall of India Pvt.Ltd)– 2006.
2	Intellectual Property rights and copyrights– EssEss Publications.
3	Primer– R. Anita Rao and Bhanoji Rao– Intellectual Property Rights– Lastain Book company.
4	Edited by Derek Bosworth and Elizabeth Webster– The Management of Intellectual Property–Edward Elgar Publishing Ltd.– 2006.

P23CAO13	ETHICAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

1	To help students develop knowledge and competence in ethical management and Decision making in organizational contexts.
2	To Managing in an ethical crisis
3	To identifying internal and external stakeholders
4	To Understand individual variables in ethics
5	To develop of techniques and skills in ethics

UNIT I	ETHICS AND SOCIETY	9

Ethical Management– Definition– Motivation– Advantages–Practical implications of ethical management. Managerial ethics– professional ethics– and social Responsibility–Role of culture and society's expectations– Individual and organizational responsibility to society and the community.

UNIT II	ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS	9

Managing in an ethical crisis– the nature of a crisis– ethics in crisis management– discuss case studies– analyze real–world scenarios– develop ethical management skills– knowledge– and competencies. Proactive crisis management.

UNIT III	STAKEHOLDERS IN ETHICAL MANAGEMENT	9

Stakeholders in ethical management– identifying internal and external stakeholders– nature of stakeholders– ethical management of various kinds of stakeholders: customers (product and service issues)– employees (leadership– fairness– justice– diversity) suppliers– collaborators– business– community– the natural environment (the sustainability imperative– green management– Contemporary issues).

UNIT IV	INDIVIDUAL VARIABLES IN ETHICAL MANJAGEMENT	9

Understanding individual variables in ethics– managerial ethics– concepts in ethical psychology– ethical awareness– ethical courage– ethical judgment– ethical foundations– ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision– making and management.

UNIT V	PRACTICAL FIELD–GUIDE– TECHNIQUES AND SKILLS	9

Ethical management in practice– development of techniques and skills– navigating challenges and dilemmas– resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1	Role modelling and influencing the ethical and cultural context.
CO2	Respond to ethical crises and proactively address potential crises situations.
CO3	Understand and implement stakeholder management decisions.
CO4	Develop the ability– knowledge– and skills for ethical management.
CO5	Develop practical skills to navigate– resolve and thrive in management situations
CO6	Resolving issues and preventing unethical management

TEXT BOOKS:	
1	Steiner& Steiner– Business–Government &Society: A managerial Perspective
2	BradAgle–AaronMiller–BillO'Rourke– The Business Ethics Field Guide: the essential company onto leading your career and yourcompany–2016.
REFERENCES	
1	Brad Agle– Aaron Miller– Bill O' Rourke– The Business Ethics Field Guide: the essentialcompanion to leading your career and your company– 2016.
2	Steiner & Steiner– Business– Government & Society: A managerial Perspective–
3	2011Lawrence & Weber– Business and Society: Stakeholders– Ethics– Public Policy– 2020.

P23CAO14	IOT FOR SMART SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1	To study about **Internet of Things** technologies and its role in real time applications.
2	To introduce the infrastructure required for IOT
3	To familiarize the accessories and communication techniques for IOT.
4	To provide insight about the embedded processor and sensors required for IOT
5	To familiarize the different platforms and Attributes for IOT

UNIT I	INTRODUCTION TO INTERNET OF THINGS	9

Overview– Hardware and software requirements for IOT– Sensor and actuators– Technology drivers– Business drivers– Typical IOT applications– Trends and implications.

UNIT II	IOT ARCHITECTURE	9

IOT reference model and architecture –Node Structure – Sensing– Processing– Communication– Powering– Networking – Topologies– Layer/Stack architecture– IOT standards– Cloud computing for IOT– Bluetooth– Bluetooth Low Energy beacons.

UNIT III	PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT	9

NFC– SCADA and RFID– ZigBee MIPI– M–PHY– UniPro– SPMI– SPI– M–PCIe GSM– CDMA–LTE– GPRS– small cell. **Wireless technologies for IoT:** Wi-Fi (IEEE 80211)– Bluetooth/ Bluetooth Smart– ZigBee/ZigBee Smart– UWB (IEEE 80215.4)– 6LoWPAN– Proprietary systems–Recent trends.

UNIT IV	IOT PROCESSORS	9

Services/Attributes: Big–Data Analytics for IOT– Dependability–Interoperability– Security– Maintainability. **Embedded processors for IOT** :Introduction to Python programming –Building IOT with RASPERRY PI and Arduino.

UNIT V	CASE STUDIES	9

Industrial IOT– Home Automation– smart cities– Smart Grid– connected vehicles– electric vehicle charging– Environment– Agriculture– Productivity Applications– IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1	Analyze the concepts of IOT and it present developments.
CO2	Compare and contrast different platforms and infrastructures available for IOT
CO3	Explain different protocols and communication technologies used in IOT
CO4	Analyze the big data analytic and programming of IOT
CO5	Implement IOT solutions for smart applications
CO6	Productivity Applications

TEXT BOOKS:	
1	Adrian McEwen and Hakim Cassimally“ Designing the Internet of Things“Wiley–2014
2	Jean– Philippe Vasseur– Adam Dunkels– “Interconnecting Smart Objects with IP: TheNext Internet” Morgan Kuffmann Publishers– 2010.
REFERENCES	
1	Arshdeep Bahga and Vijai Madisetti A Hands–onApproach “Internet of Things”– Universities Press 2015.
2	Oliver Hersent – David Boswarthick and Omar Elloumi “ The Internet of Things”– Wiley–2016.
3	Samuel Greengard– “ The Internet of Things”– The MIT press– 2015.

P23CAO15	MACHINE LEARNING AND DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course is aimed at:

1	Understanding about the learning problem and algorithms
2	Providing insight about neural networks
3	Introducing the machine learning fundamentals and significance
4	Enabling the students to acquire knowledge about pattern recognition.
5	Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I	LEARNING PROBLEMS AND ALGORITHMS	9

Various paradigms of learning problems– Supervised– Semi–supervised and Unsupervised algorithms

UNIT II	NEURAL NETWORKS	9

Differences between Biological and Artificial Neural Networks – Typical Architecture– Common Activation Functions– Multi–layer neural network– Linear Separability– Hebb Net– Perceptron– Adeline– Standard Back propagation Training Algorithms for Pattern Association – Hebb rule and Delta rule– Hetero associative– Auto associative– Kohonen Self Organizing Maps– Examples of Feature Maps– Learning Vector Quantization– Gradient descent– Boltzmann Machine Learning.

UNIT III	MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS	9

Classifying Samples: The confusion matrix– Accuracy– Precision– Recall– F1– Score– the curse of dimensionality– training– testing– validation– cross validation– overfitting– under–fitting the data– early stopping– regularization– bias and variance. Feature Selection– normalization– dimensionality reduction– Classifiers: KNN– SVM– Decision trees– Naïve Bayes– Binary classification– multi class classification– clustering.

UNIT IV	DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS	9

Feed forward networks– Activation functions– back propagation in CNN– optimizers– batch normalization– convolution layers– pooling layers– fully connected layers– dropout– Examples of CNNs.

UNIT V	DEEP LEARNING: RNNS– AUTOENCODERS AND GANS	9

State– Structure of RNN Cell– LSTM and GRU– Time distributed layers– Generating Text– Auto encoders: Convolutional Auto encoders– Denoising auto encoders–Variational auto encoders– GANs: The discriminator– generator– DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES	
At the end of the course the student will be able to	
CO1	Illustrate the categorization of machine learning algorithms.
CO2	Compare and contrast the types of neural network architectures– activation functions
CO3	Acquaint with the pattern association using neural networks
CO4	Elaborate various terminologies related with pattern recognition and architectures of convolution neural networks.
CO5	Construct different feature selection and classification techniques and advanced neural network architectures such as RNN– Auto encoders– and GANs.
CO6	Time distributed layers

TEXT BOOKS:	
1	Understanding Machine Learning. Shai Shalev–Shwartz and Shai Ben–David. CambridgeUniversity Press. 2017.
2	Deep Learning– Ian Good fellow– YoshuaBengio and Aaron Courville– MIT Press– ISBN: 9780262035613– 2016.
REFERENCES:	
1	J. S. R. Jang– C. T. Sun– E. Mizutani– Neuro Fuzzy and Soft Computing – A ComputationalApproach to Learning and Machine Intelligence– 2012– PHI learning
2	Deep Learning– Ian Good fellow– YoshuaBengio and Aaron Courville– MIT Press– ISBN:9780262035613– 2016.
3	The Elements of Statistical Learning. Trevor Hastie– Robert Tibshirani and Jerome Friedman.Second Edition. 2009.
4	Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.

P23CAO16	RENEWABLE ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on

1	Different types of renewable energy technologies
2	Standalone operation– grid connected operation of renewable energy systems
3	Block diagram of solar photo voltaic system
4	Power curve of wind turbine
5	Qualitative study of different renewable energy resources

UNIT I	INTRODUCTION	9

Classification of energy sources – Co2 Emission – Features of Renewable energy – Renewable energy scenario in India –Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption – CO2 Emission – importance of renewable energy sources– Potentials – Achievements– Applications.

UNIT II	SOLAR PHOTOVOLTAICS	9

Solar Energy: Sun and Earth–Basic Characteristics of solar radiation– angle of sunrays on solar collector–Estimating Solar Radiation Empirically – Equivalent circuit of PV Cell– Photovoltaic cell– characteristics: P–V and I–V curve of cell–Impact of Temperature and Insolation on I–V characteristics–Shading Impacts on I–V characteristics–Bypass diode –Blocking diode.

UNIT III	PHOTOVOLTAIC SYSTEM DESIGN	9

Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) – Boost and buck–boost converters – selection of inverter– battery sizing– array sizing – PV systems classification– standalone PV systems – Grid tied and grid interactive inverters– grid connection issues.

UNIT IV	WIND ENERGY CONVERSION SYSTEMS	9

Origin of Winds: Global and Local Winds– Aerodynamics of Wind turbine–Derivation of Betz's limit– Power available in wind–Classification of wind turbine: Horizontal Axis wind turbine and Verticalaxis wind turbine– Aerodynamic Efficiency–Tip Speed–Tip SpeedRatio– Solidity–Blade Count–Power curve of wind turbine – Configurations of wind energy conversion systems: Type A– Type B– Type Cand Type D Configurations– Grid connection Issues – Grid integrated SCIG and PMSG based WECS.

UNIT V	OTHER RENEWABLE ENERGY SOURCES	9

Qualitative study of different renewable energy resources: ocean– Biomass– Hydrogen energy systems– Fuel cells– Ocean Thermal Energy Conversion (OTEC)– Tidal and wave energy– Geothermal Energy Resources.

TOTAL : 45 PERIODS

COURSE OUTCOMES	
After completion of this course– the student will be able to:	
CO1	Demonstrate the need for renewable energy sources.
CO2	Develop a stand–alone photo voltaic system and implement a maximum power pointtracking in the PV system.
CO3	Design a stand–alone and Grid connected PV system.
CO4	Analyze the different configurations of the wind energy conversion systems.
CO5	Realize the basic of various available renewable energy sources
CO6	Classification of wind turbine

TEXT BOOKS:	
1	John Twideu and Tony Weir– "Renewal Energy Resources" BSP Publications– 2006
2	Gray– L. Johnson– "Wind energy system"– prentice hall of India– 1995.
REFERENCES:	
1	S.N.Bhadra– D. Kastha– & S. Banerjee "Wind Electrical Systems"– Oxford UniversityPress–2009.
2	Rai. G.D– "Non conventional energy sources"– Khanna publishes– 1993
3	Rai. G.D–" Solar energy utilization"– Khanna publishes– 1993
4	Chetan Singh Solanki– "Solar Photovoltaics: Fundamentals– Technologies andApplications"– PHI Learning Private Limited– 2012

P23CAO17	SMART GRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	To Study about Smart Grid technologies– different smart meters and advanced metering infrastructure.
2	To know about the function of smart grid.
3	To familiarize the power quality management issues in Smart Grid.
4	To familiarize the high performance computing for Smart Grid applications
5	To get familiarized with the communication networks for Smart Grid applications

UNIT I	INTRODUCTION TO SMART GRID	9

Evolution of Electric Grid– Concept– Definitions and Need for Smart Grid– Smart grid drivers– functions– opportunities– challenges and benefits– Difference between conventional & Smart Grid– Comparison of Micro grid and Smart grid– Present development & International policies in Smart Grid– Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II	SMART GRID TECHNOLOGIES	9

Technology Drivers– Smart Integration of energy resources– Smart substations– Substation Automation– Feeder Automation –Transmission systems: EMS– FACTS and HVDC– Wide area monitoring– Protection and control– Distribution systems: DMS– Volt/Var control– Fault Detection– Isolation and service restoration– Outage management– High–Efficiency Distribution Transformers– Phase Shifting Transformers– Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts

UNIT III	SMART METERS AND ADVANCED METERING INFRASTRUCTURE	9

Introduction to Smart Meters– Advanced Metering infrastructure (AMI) drivers and benefits– AMI protocols– standards and initiatives– AMI needs in the smart grid– Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs– Demand pricing and Time of Use– Real Time Pricing– Peak Time Pricing.

UNIT IV	POWER QUALITY MANAGEMENT IN SMART GRID	9

Power Quality & EMC in Smart Grid– Power Quality issues of Grid connected Renewable Energy Sources– Power Quality Conditioners for Smart Grid– Web based Power Quality monitoring– Power Quality Audit.

UNIT V	HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS	9

Architecture and Standards –Local Area Network (LAN)– House Area Network (HAN)– Wide Area Network (WAN)– Broadband over Power line (BPL)– PLC– Zigbee– GSM– IP based Protocols– Basicsof Web Service and CLOUD Computing– Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME	
Students able to	
CO1	Relate with the smart resources– smart meters and other smart devices.
CO2	Explain the function of Smart Grid.
CO3	Experiment the issues of Power Quality in Smart Grid.
CO4	Analyze the performance of Smart Grid.
CO5	Recommend suitable communication networks for smart grid applications
CO6	Architecture and Standards
TEXT BOOK:	
1	SMART GRID Fundamentals of Design and Analysis– James Momoh– IEEE press– A JohnWiley & Sons– Inc.– Publication
2	Mini S. Thomas– John D McDonald– 'Power System SCADA and Smart Grids'– CRC Press–2015
REFERENCES	
1	Stuart Borlase 'Smart Grid: Infrastructure– Technology and Solutions'– CRC Press 2012
2	JanakaEkanayake– Nick Jenkins– KithsiriLiyanage– Jianzhong Wu– Akihiko Yokoyama– 'Smart Grid: Technology and Applications'– Wiley– 2012
3	Mini S. Thomas– John D McDonald– 'Power System SCADA and Smart Grids'– CRC Press– 2015
4	Kenneth C.Budka– Jayant G. Deshpande– Marina Thottan– 'Communication Networks forSmart Grids'– Springer– 2014

P23CAO18	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1	To understand the basics of big data analytics
2	To understand the search methods and visualization
3	To learn mining data streams
4	To learn frameworks
5	To gain knowledge on R language

UNIT I	INTRODUCTION TO BIG DATA	9

Introduction to Big Data Platform – Challenges of Conventional Systems – Intelligent data analysis–Nature of Data – Analytic Processes and Tools – Analysis Vs Reporting – Modern Data Analytic Tools– Statistical Concepts: Sampling Distributions – Re–Sampling – Statistical Inference – Prediction Error.

UNIT II	SEARCH METHODS AND VISUALIZATION	9

Search by simulated Annealing – Stochastic– Adaptive search by Evaluation – Evaluation Strategies –Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques

UNIT III	MINING DATA STREAMS	9

Introduction To Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) Applications – Case Studies – Real Time Sentiment Analysis– Stock Market Predictions

UNIT IV	FRAMEWORKS	9

Map Reduce – Hadoop– Hive– MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed File Systems – Case Study– Preventing Private Information Inference Attacks on Social Networks– Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V	R LANGUAGE	9

Overview– Programming structures: Control statements –Operators –Functions – Environment and scope issues –Recursion –Replacement functions– R data structures: Vectors –Matrices and arrays – Lists –Data frames –Classes– Input/output– String manipulations

TOTAL:45 PERIODS

COURSE OUTCOMES	
CO1	understand the basics of big data analytics
CO2	Ability to use Hadoop– Map Reduce Framework.
CO3	Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4	gain knowledge on R language
CO5	Contextually integrate and correlate large amounts of information to gain faster insights.
CO6	Overview of Programming structures

TEXT BOOK:	
1	Glenn J. Myatt– Making Sense of Data– John Wiley & Sons– 2007.
2	Norman Matl off– The Art of R Programming: A Tour of Statistical Software Design–NoStarch Press–USA–2011
REFERENCE	
1	Michael Berthold– David J. Hand– Intelligent Data Analysis– Springer– 2007.
2	Anand Rajaraman and Jeffrey David Ullman– Mining of Massive Datasets– CambridgeUniversity Press– 3rd edition 2020.
3	Norman Matloff– The Art of R Programming: A Tour of Statistical SoftwareDesign– No Starch Press– USA– 2011
4	Bill Franks– Taming the Big Data Tidal Wave: Finding Opportunities in Huge DataStreams with Advanced Analytics– John Wiley & sons– 2012

P23CAO19	INTERNET OF THINGS AND CLOUD	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	To understand Smart Objects and IoT Architectures
2	To learn about various IOT–related protocols
3	To build simple IoT Systems using Arduino and Raspberry Pi.
4	To understand data analytics and cloud in the context of IoT
5	To develop IoT infrastructure for popular application

UNIT I	FUNDAMENTALS OF IOT	9

Introduction to IOT – IOT definition – Characteristics – IOT Complete Architectural Stack – IOT enabling Technologies – IOT Challenges. Sensors and Hardware for IOT – Hardware Platforms – Arduino– Raspberry Pi– Node MCU. A Case study with any one of the boards and data acquisition from sensors

UNIT II	PROTOCOLS FOR IOT	9

Infrastructure protocol (IPV4/V6/RPL)– Identification (URIs)– Transport (Wifi– Lifi– BLE)– Discovery– Data Protocols– Device Management Protocols. – A Case Study with MQTT/COAP usage–IOT privacy– security and vulnerability solutions

UNIT III	CASE STUDIES/INDUSTRIAL APPLICATIONS	9

Case studies with architectural analysis: IOT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV	CLOUD COMPUTING INTRODUCTION	9

Introduction to Cloud Computing – Service Model – Deployment Model– Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.

UNIT V	IOT AND CLOUD	9

IOT and the Cloud – Role of Cloud Computing in IOT – AWS Components – S3 – Lambda – AWS IOT Core –Connecting a web application to AWS IOT using MQTT– AWS IOT Examples. Security Concerns– Risk Issues– and Legal Aspects of Cloud Computing– Cloud Data Security.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1	Understand the various concept of the IOT and their technologies
CO2	Develop IOT application using different hardware platforms
CO3	Implement the various IOT Protocols
CO4	Understand the basic principles of cloud computing
CO5	Develop and deploy the IOT application into cloud environment
CO6	Role of Cloud Computing in IOT

TEXT BOOK:	
1	Bart Baesens– "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications"– Wiley Publishers– 2015.
2	Adrian McEwen– Designing the Internet ofThings–Wiley–2013
REFERENCES	
1	The Internet of Things: Enabling Technologies– Platforms– and Use Cases"– by Pethuru Raj and Anupama C. Raman –CRC Press– 2017
2	Adrian McEwen– Designing the Internet of Things– Wiley–2013
3	EMC Education Services– "Data Science and Big Data Analytics: Discovering– Analyzing– Visualizing and Presenting Data"– Wiley publishers– 2015.
4	Simon Walkowiak– "Big Data Analytics with R" PackT Publishers– 2016

P23CAO20	MEDICAL ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	To explain the basic concepts of robots and types of robots
2	To explain the basic concepts of robots and types of robots
3	To impart knowledge on various types of sensors and power sources
4	To explore various applications of Robots in Medicine
5	To explore various applications of Robots in Medicine

UNIT I	INTRODUCTION TO ROBOTICS	9

Introduction to Robotics– Overview of robot subsystems– Degrees of freedom– configurations and concept of workspace– Dynamic Stabilization

Sensors and Actuators Sensors and controllers– Internal and external sensors– position– velocity and acceleration sensors– Proximity sensors– force sensors Pneumatic and hydraulic actuators– Stepper motor control circuits– End effectors– Various types of Grippers– PD and PID feedback actuator models

UNIT II	MANIPULATORS & BASIC KINEMATICS	9

Construction of Manipulators– Manipulator Dynamic and Force Control– Electronic and pneumatic manipulator– Forward Kinematic Problems– Inverse Kinematic Problems– Solutions of Inverse Kinematic problems **Navigation and Treatment Planning** Variable speed arrangements– Path determination – Machinery vision– Ranging – Laser – Acoustic– Magnetic– fiber optic and Tactile sensor

UNIT III	SURGICAL ROBOTS	9

Da Vinci Surgical System– Image guided robotic systems for focal ultrasound based surgical applications– System concept for robotic Tele–surgical system for off–pump– CABG surgery– Urologic applications– Cardiac surgery– Neuro–surgery– Pediatric and General Surgery– Gynecologic Surgery– General Surgery and Nanorobotics. Case Study

UNIT IV	REHABILITATION AND ASSISTIVE ROBOTS	9

Pediatric Rehabilitation– Robotic Therapy for the Upper Extremity and Walking– Clinical– Based Gait Rehabilitation Robots– Motion Correlation and Tracking– Motion Prediction– Motion Replication. Portable Robot for Tele rehabilitation– Robotic Exoskeletons – Design considerations–Hybrid assistive limb. Case Study

UNIT V	WEARABLE ROBOTS	9

Augmented Reality– Kinematics and Dynamics for Wearable Robots– Wearable Robot technology– Sensors– Actuators– Portable Energy Storage– Human–robot cognitive interaction (CHRI)– Human– robot physical interaction (PHRI)– Wearable Robotic Communication – case study

TOTAL:45 PERIODS

COURSE OUTCOMES	
CO1	Describe the configuration– applications of robots and the concept of grippers and actuators
CO2	Explain the functions of manipulators and basic kinematics
CO3	Describe the application of robots in various surgeries
CO4	Design and analyze the robotic systems for rehabilitation
CO5	Design the wearable robots
CO6	Based Gait Rehabilitation Robots
TEXT BOOK:	
1	Shane (S.Q.) Xie– Advanced Robotics for Medical Rehabilitation – Current State of the Art and Recent Advances– Springer– 2016
2	Sashi S Kommu– Rehabilitation Robotics– I–Tech Education and Publishing– 2007
REFERENCES	
1	Nagrath and Mittal– "Robotics and Control"– Tata McGraw Hill– First edition– 2003
2	Spong and Vidhyasagar– "Robot Dynamics and Control"– John Wiley and Sons– Firstedition– 2008
3	Fu.K.S– Gonzalez. R.C.– Lee– C.S.G– "Robotics– control"– sensing– Vision and Intelligence– Tata McGraw Hill International– First edition– 2008
4	Bruno Siciliano– Oussama Khatib– Springer Handbook of Robotics– 1st Edition– Springer–2008

P23CAO21	EMBEDDED AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	To learn about the process involved in the design and development of real–time Embedded system
2	To develop the embedded C programming skills on 8–bit microcontroller
3	To study about the interfacing mechanism of peripheral devices with 8–bit microcontrollers
4	To learn about the tools– firmware related to microcontroller programming
5	To build a home automation system

UNIT I	INTRODUCTION TO EMBEDDED C PROGRAMMING	9

C Overview and Program Structure – C Types– Operators and Expressions – C Control Flow – C Functions and Program Structures – C Pointers And Arrays – FIFO and LIFO – C Structures – Development Tools

UNIT II	AVR MICROCONTROLLER	9

ATMEGA 16 Architecture – Nonvolatile and Data Memories – Port System – Peripheral Features : Time Base– Timing Subsystem– Pulse Width Modulation– USART– SPI– Two Wire Serial Interface– ADC– Interrupts – Physical and Operating Parameters

UNIT III	HARDWARE AND SOFTWARE INTERFACING WITH 8–BIT SERIES CONTROLLERS	9

Lights and Switches – Stack Operation – Implementing Combinational Logic – Expanding I/O – Interfacing Analog To Digital Convertors – Interfacing Digital To Analog Convertors – LED Displays : Seven Segment Displays– Dot Matrix Displays – LCD Displays – Driving Relays – Stepper Motor Interface – Serial EEPROM – Real Time Clock – Accessing Constants Table – Arbitrary Waveform Generation – Communication Links – System Development Tools

UNIT IV	VISION SYSTEM	9

Fundamentals of Image Processing – Filtering – Morphological Operations – Feature Detection and Matching – Blurring and Sharpening – Segmentation – Thresholding – Contours – Advanced Contour Properties – Gradient – Canny Edge Detector – Object Detection – Background Subtraction

UNIT V	HOME AUTOMATION	9

Home Automation – Requirements – Water Level Notifier – Electric Guard Dog – Tweeting Bird Feeder – Package Delivery Detector – Web Enabled Light Switch – Curtain Automation – Android Door Lock – Voice Controlled Home Automation – Smart Lighting – Smart Mailbox – ElectricityUsage Monitor –Proximity Garage Door Opener – Vision Based Authentic Entry System

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
On successful completion of this course– students will be able to	
CO1	analyze the 8–bit series microcontroller architecture– features and pin details
CO2	write embedded C programs for embedded system application
CO3	Design and develop real time systems using AVR microcontrollers
CO4	Design and develop the systems based on vision mechanism
CO5	Design and develop a real time home automation system
CO6	Voice Controlled Home Automation
TEXT BOOK:	
1	Richard Szeliski– "Computer Vision: Algorithms and Applications"– Springer– 2011
2	Kevin P. Murphy– "Machine Learning – a Probabilistic Perspective"– the MIT PressCambridge– Massachusetts– London– 2012
REFERENCES	
1	Dhananjay V. Gadre– "Programming and Customizing the AVR Microcontroller"– McGraw–Hill– 2001
2	Joe Pardue– "C Programming for Microcontrollers "– Smiley Micros– 2005.
3	Steven F. Barrett– Daniel J. Pack– "ATMEL AVR Microcontroller Primer : Programming andInterfacing"– Morgan & Claypool Publishers– 2012
4	Mike Riley– "Programming Your Home – Automate With Arduino– Android and YourComputer"– the Pragmatic Programmers– Llc– 2012

P23CAO22	ENVIRONMENTAL SUSTAINABILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	To Valuing the Environment: Methods
2	To Defining the Concept of the Population Problem
3	To Biodiversity of Forest Habitat
4	To control toxic Substances and Hazardous Wastes
5	To Visions of the Future

UNIT I	INTRODUCTION	9

Valuing the Environment: Concepts– Valuing the Environment: Methods– Property Rights– Externalities– and Environmental Problems

UNIT II	CONCEPT OF SUSTAINABILITY	9

Sustainable Development: Defining the Concept– the Population Problem– Natural Resource Economics: An Overview– Energy– Water– Agriculture

UNIT III	SIGNIFICANCE OF BIODIVERSITY	9

Biodiversity– Forest Habitat– Commercially Valuable Species– Stationary – Source Local Air Pollution– Acid Rain and Atmospheric Modification– Transportation

UNIT IV	POLLUTION IMPACTS	9

Water Pollution– Solid Waste and Recycling– Toxic Substances and Hazardous Wastes– Global Warming.

UNIT V	ENVIRONMENTAL ECONOMICS	9

Development– Poverty– and the Environment– Visions of the Future– Environmental economics and policy by Tom Tieten berg– Environmental Economics

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course– students will be able to

CO1	Valuing the Environment: Concepts
CO2	The Population Problem
CO3	Acid Rain and Atmospheric Modification
CO4	Sustainable Development
CO5	Solid Waste and Recycling
CO6	Visions of the Future

TEXT BOOK:

1	Stephen Doven–Environment and SustainabilityPolicy:Creation–Implementation–Evaluation– the Federation Press–2005
2	Robert Brinkmann.–Introduction to Sustainability–Wiley–Blackwell.–2016

REFERENCES	
1	Andrew Hoffman– Competitive Environmental Strategy – A Guide for the Changing Business Landscape– Island Press.
2	Stephen Doven– Environment and Sustainability Policy: Creation– Implementation– Evaluation– the Federation Press– 2005
3	Robert Brinkmann.– Introduction to Sustainability– Wiley–Blackwell.– 2016
4	Niko Roorda.– Fundamentals of Sustainable Development– 3rd Edn– Routledge– 2020

P23CAO23	TEXTILE REINFORCED COMPOSITES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	To preparation of re in forced materials
2	To quality evaluation and performs for various composites
3	To Classify the methods of composites manufacturing.
4	To test the Fiber volume and weight fraction
5	To inter laminar shear stress and fatigue properties of thermo set

UNIT I	REINFORCEMENTS	9

Introduction – composites –classification and application; reinforcements– fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II	MATRICES	9

Preparation– chemistry– properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III	COMPOSITE MANUFACTURING	9

Classification; methods of composites manufacturing for both thermoplastics and thermosets– Hand layup– Filament Winding– Resin transfer moulding– prepregs and autoclave moulding– pultrusion– vacuum impregnation methods– compression moulding; post processing of composites and composite design requirements

UNIT IV	TESTING	9

Fibre volume and weight fraction– specif ic gravity of composites– tensile– f lexural– impact– compression– inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V	MECHANICS	9

Micro mechanics– macro mechanics of single layer– macro mechanics of laminate– classical lamination theory– failure theories and prediction of inter laminar stresses using at ware

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course– students will be able to

CO1	classification and application
CO2	fibers and its properties
CO3	Optimization of matrices
CO4	Methods of composites manufacturing for both thermos plastics and thermos sets
CO5	compression– inter laminar shear stress
CO6	Macro mechanics of laminate

TEXT BOOK:	
1	RichardM. Christensen–"Mechanics of composite materials"–DoverPublications–2005.
2	Sanjay K. Mazumdar– "Composites Manufacturing: Materials– Product– and ProcessEngineering"–CRCPress–2001
REFERENCES	
1	BorZ.Jang–"Advanced Polymer composites"–ASM International–USA–1994
2	Carlsson L.A. and Pipes R.B.– "Experimental Characterization of advanced composite Materials"–SecondEdition–CRCPress–NewJersey–1996.
3	George Lubinand Stanley T.Peters– "Handbook of Composites"– Springer Publications– 1998.
4	Mel. M. Schwartz– "Composite Materials"– Vol. 1 &2– Prentice Hall PTR– NewJersey–1997.

P23CAO24	NANOCOMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1	To Characterization of Structure and Physical properties
2	To simple preparation techniques and their properties
3	To characterization of dib lock Copolymer based nano composites
4	To Use of synthetic nano composites for bone
5	To Nano composite membrane structures

UNIT I	BASICS OF NANOCOMPOSITES	9

Nomenclature– Properties– features and processing of nanocomposites. Sample Preparation and Characterization of Structure and Physical properties. Designing– stability and mechanical properties and applications of super hard nanocomposites

UNIT II	METAL BASED NANOCOMPOSITES	9

Metal–metal nanocomposites– some simple preparation techniques and their properties. Metal– Oxide or Metal–Ceramic composites– Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass–metal nanocomposites– its designing and fractal dimension analysis. Core–Shell structured nanocomposites

UNIT III	POLYMER BASED NANOCOMPOSITES	9

Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites– their mechanical properties– and industrial possibilities.

UNIT IV	NANOCOMPOSITE FROM BIOMATERIALS	9

Natural nanocomposite systems – spider silk– bones– shells; organic–inorganic nanocomposite formation through self–assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone– teeth replacement.

UNIT V	NANOCOMPOSITE TECHNOLOGY	9

Nanocomposite membrane structures– Preparation and applications. Nanotechnology in Textiles and Cosmetics–Nano–fillers embedded polypropylene fibers – Soil repellence– Lotus effect – Nano finishing in textiles (UV resistant– anti–bacterial– hydrophilic– self–cleaning– flame retardant finishes)–Sun–screen dispersions for UV protection using titanium oxide – Color cosmetics. Nanotechnology in Food Technology – Nano packaging for enhanced shelf life – Smart/Intelligent packaging.

TOTAL : 45 PERIODS

COURSE OUTCOMES:	
On successful completion of this course– students will be able to	
CO1	Structure and Physical properties
CO2	Nanotechnology in Textiles and Cosmetics–
CO3	Their final properties and functionality
CO4	techniques and their final properties and functionality
CO5	Nano–fillers embedded polypropylene fibers Soil repellence
CO6	UV protection using titanium oxide

TEXT BOOK:	
1	The search for novel– superhard materials– Stan Vepr¡ek (Review Article) JVST
2	Nanometer versus micrometer–sized particles–Christian Brosseau– Jamal BeN Youssef– Philippe Talbot– Anne–Marie Konn– (Review Article) J. Appl. Phys– Vol 93– 2003
REFERENCES	
1	Introduction to Nanocomposite Materials. Properties– Processing– Characterization–Thomas E. Twardowski. 2007. DEStech Publications. USA.
2	Nanocomposites Science and Technology – P. M. Ajayan– L.S. Schadler– P. V.Braun 2006.
3	Physical Properties of Carbon Nanotubes– R. Saito 1998.
4	Carbon Nanotubes (Carbon – Vol 33) – M. Endo– S. Iijima– M.S. Dresselhaus 1997.

P23CAO25	IPR– BIOSAFETY AND ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1	Application preparation filing and prosecution
2	Forms and fees Invention in context of "prior art"
3	Introduction to existing schemesPatent licensing and agreement Patent infringement
4	Introduction to Biological Safety Cabinets
5	Risk management and communication

UNIT I	IPR	9

Intellectual property rights – Origin of the patent regime – Early patents act & Indian pharmaceutical industry – Types of patents – Patent Requirements – Application preparation filing and prosecution – Patentable subject matter – Industrial design– Protection of GMO's IP as a factor in R&D–IP's of relevance to biotechnology and few case studies

UNIT II	AGREEMENTS– TREATIES AND PATENT FILING PROCEDURES	9

History of GATT Agreement – Madrid Agreement – Hague Agreement – WIPO Treaties – Budapest Treaty – PCT – Ordinary – PCT – Conventional – Divisional and Patent of Addition – Specifications – Provisional and complete – Forms and fees Invention in context of "prior art" – Patent databases – Searching International Databases – Country–wise patent searches (USPTO–spacemen(EPO) – PATENT Scope (WIPO) – IPO– etc National & PCT filing procedure– Time frame and cost – Status of the patent applications filed – Precautions while patenting – disclosure/non–disclosure – Financial assistance for patenting – Introduction to existing schemes Patent licensing and agreement Patent infringement –Meaning– scope– litigation– case studies

UNIT III	BIOSAFETY	9

Introduction – Historical Background – Introduction to Biological Safety Cabinets – Primary Containment for Biohazards – Biosafety Levels – Biosafety Levels of Specific Microorganisms – Recommended Biosafety Levels for Infectious Agents and Infected Animals – Biosafety guidelines – Government of India.

UNIT IV	GENETICALLY MODIFIED ORGANISMS	9

Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

UNIT V	ENTREPRENEURSHIP DEVELOPMENT	9

Introduction – Entrepreneurship Concept – Entrepreneurship as a career – Entrepreneurial personality – Characteristics of successful Entrepreneur – Factors affecting entrepreneurial growth – Entrepreneurial Motivation – Competencies – Mobility – Entrepreneurship Development Programmed (EDP) – Launching Of Small Enterprise – Definition– Characteristics – Relationship between small and large units – Opportunities for an Entrepreneurial career – Role of small enterprise in economic development – Problems of small-scale industries – Institutional finance to entrepreneurs – Institutional support to entrepreneurs.

TOTAL : 45 PERIODS

COURSE OUTCOMES:	
On successful completion of this course– students will be able to	
CO1	National Regulations and relevant International Agreements including Cartegana Protocol.
CO2	Characteristics of successful Entrepreneur
CO3	Searching International Databases
CO4	Entrepreneurship Development Programmes
CO5	Recommended Biosafety Levels for Infectious Agents and Infected Animals
CO6	Launching Of Small Enterprise
TEXT BOOK:	
1	Bouchoux– D.E.– "Intellectual Property: The Law of Trademarks– Copyrights– Patents– and Trade Secrets for the Paralegal"– 3rd Edition– Delmar Cengage Learning– 2008.
2	Fleming– D.O. and Hunt– D.L.– "Biological Safety: Principles and Practices"– 4th Edition– American Society for Microbiology– 2006.
REFERENCES	
1	Irish– V.– "Intellectual Property Rights for Engineers"– 2nd Edition– The Institution of Engineering and Technology– 2005.
2	Mueller– M.J.– "Patent Law"– 3rd Edition– Wolters Kluwer Law & Business– 2009
3	Young– T.– "Genetically Modified Organisms and Biosafety: A Background Paper for Decision– Makers and Others to Assist in Consideration of GMO Issues" 1st Edition– World Conservation Union– 2004
4	S.S Khanka– "Entrepreneurial Development"– S.Chand & Company LTD– New Delhi– 2007.

P23CAO26	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the basics of Block chain .
2	To understand the basics of Crypto currency.
3	To understand the working of digital tokens and wallets.
4	To understand the working of contracts.
5	To understand the working of block chain platform.

UNIT I	OVERVIEW OF BLOCKCHAIN	9

Block chain – The Structure of Block chain – Data Structure of Block chain – Data Distribution in 53 Block chain – Block Validation. Block Validators: Consensus – Proof of Work – Proof of Stake – Proof of Activity – Proof of Elapsed Time – Proof of Burn.

UNIT II	INTRODUCTION TO BITCOIN	9

Key concepts of Bitcoin – Merits Fork and Segwits – Sending and Receiving Bitcoins, Choosing Bitcoin Wallet, Converting Bitcoins to Fiat Currency.

UNIT III	HYPERLEDGER	8

Hyper ledger Fabric: Introduction – Fabric v/s Ethereum – Hyperledger Iroha – Features of Iroha. Hyper ledger Saw tooth: Components of saw tooth – Proof of Elapsed time.

UNIT IV	BLOCKCHAIN PLATFORMS	10

Multichain – Hydra Chain– Future Blockchain: IOTA – Corda – Chain Core. Blockchain Framework: CoCo Framework – Tierion – BigchainDB.

UNIT V	BITCOIN AND ANONYMITY	9

Anonymity Basics, How to De–anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash, Consensus in Bitcoin, Bitcoin Core Software, Stakeholders: Bitcoin as a Platform: Bitcoin as an Append only Log, Bitcoins as Smart Property, Secure Multi Party Lotteries in Bitcoin, Bitcoin as Public Randomness, Source–Prediction Markets, and Real World Data Feeds.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Identify Block Chain as Data structure and Distribution Data
CO2	Implement the transactions of Crypto currency
CO3	identify the different ways to achieve Block chain Technology
CO4	Design and build smart contracts
CO5	Use smart contract for real world application in a Blockchain Platform
CO6	Use Prediction Markets and Real World Data Feeds.
TEXT BOOKS:	
1	Blockchain Programming', Create Space Independent Publishing Platform, 1st Edition, 2017.
2	Technology that Powers Them, Mango Publishing group, 2018
REFERENCE BOOKS:	
1	Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guide to Blockchain Technology
2	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. 1st Edition, Princeton University Press, 2016.
3	Joseph Bonneau et al, SoK: Research perspectives and challenges for Bit coin and crypto currency, IEEE Symposium on security and Privacy, 1st Edition, 2015.
4	Antony Lewis, The Basics of Bitcoins and Blockchains: An Introduction to Crypto currencies 54 and the Technology that Powers Them, Mango Publishing group, 2018

P23CAO27	PROFESSIONAL ETHICS IN IT	L	T	P	C
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COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1	To understand the concepts of computer ethics in the work environment.
2	To understand the threats in computing environment
3	To Understand the intricacies of accessibility issues
4	To ensure safe exits when designing the software projects
5	To Understand Professional Codes of Ethics.

UNIT I INTRODUCTION TO ETHICS 9

Definition of Ethics– Right, Good, Just– The Rational Basis of Ethics –Theories of Right: Intuitionist vs. End–Based vs. Duty–Based –Rights, Duties, Obligations –Theory of Value – Conflicting Principles and Priorities –The Importance of Integrity –The Difference Between Morals, Ethics, and Laws –Ethics in the Business World –
Corporate Social Responsibility –Creating an Ethical Work Environment –Including Ethical Considerations in Decision Making.

UNIT II ETHICS IN INFORMATION TECHNOLOGY, INTERNET CRIME 9

IT Professionals – Are IT Workers Professionals– Professional Relationships That Must Be Managed –Professional Codes of Ethics – Professional Organizations – Certification – IT Professional Ethics, Three Codes of Ethics, Management Conflicts. The Reveton Ransomware Attacks –IT Security Incidents: A Major Concern – Why Computer Incidents Are So Prevalent – Types of Exploits –Types of Perpetrators–Federal Laws for Prosecuting Computer Attacks– Implementing Trustworthy Computing –Risk Assessment –Establishing a Security Policy – Educating Employees and Contract Workers.

UNIT III FREEDOM OF EXPRESSION, PRIVACY 9

First Amendment Rights –Obscene Speech–Defamation –Freedom of Expression: Key Issues – Controlling Access to Information on the Internet –Strategic Lawsuit Against Public Participation (SLAPP)–Anonymity on the Internet–Hate Speech– Privacy Protection and the Law– Information Privacy– Privacy Laws, Applications, and Court Rulings–Key Privacy and Anonymity Issues–
Data Breaches –Electronic Discovery–Consumer Profiling– Workplace Monitoring –Advanced Surveillance Technology.

UNIT IV FREEDOM OF EXPRESSION, INTELLECTUAL PROPERTY RIGHTS 9

Intellectual Property Rights–Copyrights–Copyright Term – Eligible Works –Fair Use Doctrine – Software Copyright Protection –Copyright Laws and the internet–Copyright and Piracy–Patents– –Software Patents –Cross–Licensing Agreements –Trade Secrets–Trade Secret Laws –Employees and Trade Secrets–Key Intellectual Property Issues–Plagiarism –Reverse Engineering–Open Source Code– Competitive Intelligence –Trademark Infringement –Cyber squatting.

UNIT V SOCIAL NETWORKING ETHICS AND ETIQUETTES 9

Social Networking Web Site– Business Applications of Online Social Networking–Social Network Advertising–The Use of Social Networks in the Hiring Process–Social Networking Ethical Issues –Cyber bullying– Online Virtual Worlds–Crime in Virtual Worlds–Educational and Business Uses of Virtual Worlds.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course the students would be able to	
CO1	Examine situations and to internalize the need for applying ethical principles, values to tackle various situations.
CO2	Develop a responsible attitude towards the use of computers as well as the technology.
CO3	Envision the societal impact on the products/ projects they develop in their career.
CO4	Understand the code of ethics and standards of computer professionals.
CO5	Analyze professional responsibility and empower access to information in the workplace.
CO6	Understand about the Cybersquatting.
TEXT BOOKS:	
1	Douglas Adeney, Computer and Information Ethics, Greenwood Press,FirstEdition1997.
2	Barger, Robert. (2008). Computer ethics: A case–based approach. Cambridge University Press 1stEdition.
REFERENCE BOOKS:	
1	Caroline Whitback, ”Ethics in Engineering Practice and Research“, Cambridge University Press, 2nd Edition 2011
2	George Reynolds, “Ethics in Information Technology”, Cengage Learning, 6thEdition 2018.
3	Barger, Robert. (2008). Computer ethics: A case–based approach.Cambridge University Press 1stEdition.
4	John Weckert and Douglas Adeney, Computer and Information Ethics, Greenwood Press,FirstEdition1997.