

DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE
(An Autonomous Institution, Affiliated to Anna University, Chennai)

PERAMBALUR - 621212

REGULATIONS–2023

CHOICE BASED CREDIT SYSTEM

MASTER OF COMPUTER APPLICATION

CURRICULUM & SYLLABI



DEPARTMENT OF MASTER OF COMPUTER APPLICATION

(Applicable to students admitted from the Academic year 2023 – 2024 and subsequently under Choice Based Credit System)

VISION MISSION OF THE INSTITUTION

VISION

An active and committed centre of advanced learning focused on research and training in the fields of Engineering, Technology and Management to serve the nation better.

MISSION

- To develop eminent scholar with a life long follow up of global standards by offering UG, PG and Doctoral Programmes.
- To pursue Professional and Career growth by collaborating mutually beneficial partnership with industries and higher institutes of research.
- To promote sustained research and training with emphasis on human values and leadership qualities.
- To contribute solutions for the need based issues of our society by proper ways and means as dutiful citizen.

DEPARTMENT OF MASTER OF COMPUTER APPLICATION

ABOUT THE DEPARTMENT

Department of Computer Applications was established in the year 2001. The Department is constantly drawing inspiration and working towards excellence. The programme provides a highly-varied learning orientation for students by balancing core courses, advanced elective courses and a substantial dissertation or project with constant revisions to the programme structure to match advancements in the field. This department contributes significantly to teaching and research. It provides students industry interactions to visualize their future roles in the industry and increase their employability.

VISION

To Contribute in the area of Computer Applications by developing innovative computing professionals to achieve excellent standards of quality education by keeping pace with rapidly changing technologies, with a promising future to bring a new level of inspiration among the students.

MISSION

To strive for excellence in development and deployment of computer applications and empower the students to play key role through the competency based educational and training programs that promote planned and sustainable growth of the society, state, country and the entire world with employable technical skills consistent with latest technological innovations.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of computer science.
PEO 2	Graduates will be able to successfully pursue higher education in reputed institutions with Computer Applications.
PEO 3	Graduates will have the ability to explore research areas and produce outstanding contribution in various areas of computer science.

PROGRAM OUTCOMES (POs)

PO	Graduate Attribute
PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1	To collect requirements, analyze, design, implement and test software Systems.
PSO 2	To analyze the errors and debug them accordingly
PSO 3	To impart the Knowledge to implement Computer Programming

PEO's – PO's & PSO's MAPPING:

PEO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I.	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓
II.	✓	✓	✓	✓	✓	✓	✓		✓		✓			✓	✓
III.	✓					✓				✓	✓			✓	✓
IV	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓

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

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	P23MAT11	Mathematical Foundations for Computing Applications	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	P23CAT16	Block Chain Technologies	PC	3	3	0	0	3
PRACTICALS								
7	P23CAP11	Advanced Data Structures and Algorithms Laboratory	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

SL. 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 DBMS Programming 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

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	P23CAT31	Data Science & Machine Learning	PC	4	4	0	0	4
2	P23CAT32	Industry 4.0	PC	3	3	1	0	4
3	P23CAT33	Research Methodology and IPR	RMC	2	2	0	0	2
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	P23CAP26	Data Science Laboratory	PC	4	0	0	4	2
8	P23CAP27	Internet of Things & Cloud computing 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

SL. 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)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23MAT11	Mathematical Foundations for Computing Applications	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. 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	P23CAT16	Block Chain Technologies	PC	3	3	0	0	3
6	P23CAP11	Advanced Data Structures and Algorithms Laboratory	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 DBMS Programming Laboratory	PC	4	0	0	4	2
13	P23CAP22	Full Stack Web Development Laboratory	PC	4	0	0	4	2
14	P23CAT31	Data Science & Machine Learning	PC	4	4	0	0	4
15	P23CAT32	Industry 4.0	PC	3	3	1	0	4
16	P23CAP26	Data Science Laboratory	PC	4	0	0	4	2
17	P23CAP27	Internet of Things & Cloud Computing Laboratory	PC	4	0	0	4	2

**EMPLOYABILITY ENHANCEMENT COURSE
(EEC)**

SL. 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**

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23MAE11	Operations Research	PE	3	3	0	0	3
2	P23CAE12	Professional Ethics in IT	PE	3	3	0	0	3
3	P23CAE13	Software Testing	PE	3	3	0	0	3
4	P23CAE14	Software Quality Assurance	PE	3	3	0	0	3
5	P23CAE15	Software Architecture	PE	3	3	0	0	3

**PROFESSIONAL
ELECTIVE - II
SEMESTER II**

SL. 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**

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	P23CAE33	DevOps and Microservices	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

SL. 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

SEMESTER I

P23MAT11

MATHEMATICAL FOUNDATIONS FOR COMPUTING APPLICATIONS

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 provide mathematical background and sufficient experience on various topics of discrete mathematics like matrix algebra, logic and proofs, combinatory, graphs, algebraic structures, formal languages and finite state automata.
- 2 This course will extend student's Logical and Mathematical maturity and ability to deal with abstraction and to introduce most of the basic terminologies used in computer application courses and to create ideas to solve practical problems.

UNIT I MATRIX ALGEBRA

12

Matrices– Rank of a matrix – Solving system of equations – Eigen values and Eigenvectors– Cayley – Hamilton theorem– Inverse of a matrix.

UNIT II BASIC SET THEORY

12

Basic definitions – Venn diagrams and set operations – Laws of set theory – Principle of inclusion and exclusion – Partitions – Permutation and combination – Relations – Properties of relations – Matrices of relations – Closure operations on relations – Functions – Injective, subjective and objective functions.

UNIT III MATHEMATICAL LOGIC

12

Propositions and logical operators – Truth table – Propositions generated by a set – Equivalence and implication – Basic laws – Some more connectives – Functionally complete set of connectives – Normal forms – Proofs in propositional calculus – Predicate calculus.

UNIT IV PROBABILITY AND RANDOM VARIABLES

12

Probability – The axioms of probability – Conditional probability – Bayes's theorem – Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT V SCHEDULING BY PERT AND CPM

12

Network Construction – Critical Path Method – Project Evaluation and Review Technique – Resource Analysis in Network Scheduling.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- | | |
|-----|--|
| CO1 | Basic knowledge of matrix, set theory, functions and relations concepts needed for designing and solving problems. |
| CO2 | Logical operations and predicate calculus needed for computing skill. |
| CO3 | Design and solve Boolean functions for defined problems. |
| CO4 | Apply the acquired knowledge of formal languages to the engineering areas like Compiler Design. |
| CO5 | Apply the acquired knowledge of finite automata theory and to design discrete problems to solve by computers. |
| CO6 | Apply Mathematical Structure for Computer Science. |

TEXT BOOKS:

- 1 Gersting J.L., “Mathematical Structure for Computer Science”, 6th Edition W.H. Freeman and Co.,
- 2 Shahnaz Bathul, “Mathematical Structure for Computer Science”, 2nd Edition PHI Learning Private Limited, 2011

REFERENCE BOOKS:

- 1 David Makinson, “Sets, Logic and Maths for Computing”, Springer Indian Reprint, 2011
- 2 Grimaldi, R.P and Ramana, B.V. "Discrete and Combinatorial Mathematics", 5th Edition, Pearson Education, 2006.
- 3 Hopcroft J . E and Ullman, J.D, “Introduction to Automata Theory, Languages and Computation”, Narosa Publishing House, Delhi, 2002
- 4 Kenneth H. Rosen, “Discrete Mathematics and Its Applications”, Tata McGraw Hill, 4th Edition, 2002

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 – Mergeable–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–Warshall 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.

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/Booch), 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

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 –FilePosition –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 vs. 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 3.2”, Network Theory Ltd., First edition, 2011
- 4 John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and Expanded Edition, MIT Press, 2013

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, Intradomain 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

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**

Hyperledger Fabric: Introduction – Fabric v/s Ethereum – Hyperledger Iroha – Features of Iroha.
Hyperledger Sawtooth: Components of sawtooth – 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 and

- Blockchain Programming', Create Space Independent Publishing Platform, 1st Edition, 2017.
- 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

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

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 | Implementation of iteration function for tree traversal and Fibonacci. |

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 |

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 and thereby 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

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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”, Third Edition, Morgan Kaufmann, 2012

COURSE OBJECTIVES

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

- 1 Understand the fundamentals of Internet of Things
- 2 Study the IoT architecture and design models
- 3 Learn about the basics of IOT protocols
- 4 Build a small low cost embedded system using Raspberry
- 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 NodeJS – 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: ReactDOM – JSX – Components – Properties – Fetch API – State and Lifecycle – JS Localstorage – 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

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 AND NETWORKS**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 Risk Reporting–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.

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, Partitioners, 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.

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. |

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, 2nd Edition, 2015.
- 2 Tom White, —Hadoop: The Definitive Guide, O'Reilly, 3rd 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

COURSE OBJECTIVES

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

- 1 This module aims to introduce students to use quantitative 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.

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 Cyber squatting.

TEXT BOOKS:

- 1 Douglas Adeney, Computer and Information Ethics, Greenwood Press, First Edition 1997.
- 2 Barger, Robert. (2008). Computer ethics: A case-based approach. Cambridge University Press 1st Edition.

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, 6th Edition 2018.
- 3 Barger, Robert. (2008). Computer ethics: A case-based approach. Cambridge University Press 1st Edition.
- 4 John Weckert and Douglas Adeney, Computer and Information Ethics, Greenwood Press, First Edition 1997.

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.

COURSE OBJECTIVES

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

- 1 To do Quality concepts and productivity relationship
- 2 To do defect detection
- 3 To do metrics for software maintenance
- 4 To do Integrating quality activities in project life cycle, reviews
- 5 To do comparing quality assurance techniques and activities.

UNIT I SOFTWARE QUALITY AND ENGINEERING**9**

Quality concepts and productivity relationship, software quality factors, software quality costs, Total Quality Management (TQM), continuous improvement cycle: Plan, Do, Check and Act (PDCA), quality policy, cost of quality, quality engineering, quality planning: goal setting and strategy formation, assessment and improvement.

UNIT II SOFTWARE QUALITY ASSURANCE (SQA)**9**

Components of SQA, classification, defect detection, defect prevention, defect reduction, defect containment, QA activities in software processes, verification and validation, software review, inspection, formal verification, statistical software quality approach.

UNIT III COMPONENTS MEASUREMENT WITH REFERENCE TO SQA**9**

Metrics, product quality metrics, process quality metrics, metrics for software maintenance, quality tools for quality control, test management and organizational structures, Capability Maturity Model (CMM), Capability Maturity Model Integration (CMMI), ISO 9000, quality and quality management metrics, Deming's Principle, SQA team formation

UNIT IV QUALITY MANAGEMENT MODEL**9**

Integrating quality activities in project life cycle, reviews, software testing, strategies and implementation, Computer-Aided Software Engineering (CASE) tools, The Rayleigh model framework, code integration pattern, Problem Tracking Report (PTR), reliability growth model, Service Quality, Kano Model, Customer retention, continuous process improvement, Juran's Trilogy, TQM principles, Kaizen Technique, Statistical Quality Assurance, Mc call quality factors

UNIT V SOFTWARE QUALITY ASSURANCE BEYOND TESTING**9**

Defect prevention and process improvement, root cause analysis for defect prevention, software inspection, inspection related activities, fault tolerance and failure containment, comparing quality assurance techniques and activities.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- | | |
|------------|--|
| CO1 | Analyze inspection related activities |
| CO2 | Understand strategies and implementation |
| CO3 | Analyze comparing quality assurance techniques and activities. |
| CO4 | Comparing quality assurance techniques and activities. |
| CO5 | Analyze code integration pattern |
| CO6 | Analyze Capability Maturity Model |

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

COURSE OBJECTIVES

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

- 1 Understand software architectural requirements and drivers
- 2 Be exposed to architectural styles and views
- 3 Be familiar with architectures for emerging technologies
- 4 To do both business and technical
- 5 Be familiar with Documenting Quality Attributes

UNIT I INTRODUCTION AND ARCHITECTURAL DRIVERS 9

Introduction – Software architecture – Architectural structures – Influence of software architecture on organization – both business and technical – Architecture Business Cycle– Functional requirements – Technical constraints – Quality Attributes

UNIT II QUALITY ATTRIBUTE WORKSHOP 9

Quality Attribute Workshop – Documenting Quality Attributes – Six part scenarios – Case studies.

UNIT III ARCHITECTURAL VIEWS 9

Introduction – Standard Definitions for views – Structures and views – Representing views– available notations – Standard views – 4+1 view of RUP, Siemens 4 views, SEI's perspectives and views – Case studies

UNIT IV ARCHITECTURAL STYLES 9

Introduction – Data flow styles – Call–return styles – Shared Information styles – Event styles – Case studies for each style

UNIT V DOCUMENTING THE ARCHITECTURE 9

Good practices – Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages – Architectural Description Languages – ACME – Case studies. Special topics: SOA and Web services – Cloud Computing – Adaptive structures

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 structures |
| 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 and Beyond”, 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

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 Metrics – 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.

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.

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.

UNIT V 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.

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.

UNIT V APPLICATIONS OF COMPUTATIONAL INTELLIGENCE**9**

Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color 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 |

- CO5** neural network paradigms and its applications
CO6 Reveal different applications of these models to solve engineering and other problems.
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
- 4 Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

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.

UNIT V 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 analyse. |
| 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 Charu Aggarwal, "Social Network Data Analytics," Springer, First Edition, 2014

REFERENCE BOOKS:

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

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 Colour 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

UNIT V 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 an 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", 5th Edition, 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, Pearson Education, 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, New Delhi, 2006.
- 4 John C. Russ, "The Image Processing Handbook", 5th Edition, Prentice Hall, New Jersey, 2002

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

S. 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. |

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 Todo 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

S. 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

P23CAT31

DATA SCIENCE & MACHINE LEARNING

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COURSE OBJECTIVES

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

- 1 Building the fundamentals of data science.
- 2 Gaining practical experience in programming tools for data sciences
- 3 Empowering students with tools and techniques used in data science
- 4 Lay the foundation of machine learning and its practical applications
- 5 Prepare students for real-time problem-solving in data science.

UNIT I INTRODUCTION TO DATA SCIENCE

9

Big Data and Data Science – Datafication – Current landscape of perspectives – Skill sets needed; Matrices – Matrices to represent relations between data, and necessary linear algebraic operations on matrices – Approximately representing matrices by decompositions (SVD and PCA); Statistics: Descriptive Statistics: distributions and probability – Statistical Inference: Populations and samples – Statistical modeling – probability distributions – fitting a model – Hypothesis Testing – Intro to R/ Python.

UNIT II DATA PREPROCESSING

9

Data cleaning – data integration – Data Reduction Data Transformation and Data Discretization. Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves– Exploratory Data Analysis – Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA – The Data Science Process.

UNIT III INTRODUCTION TO MACHINE LEARNING

9

Association Rule mining – Linear Regression– Logistic Regression – Classifiers – k-Nearest Neighbors (k-NN), k-means –Decision tree – Naive Bayes– Ensemble Methods – Random Forest. Feature Generation and Feature Selection – Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

UNIT IV CLUSTERING

9

Choosing distance metrics – Different clustering approaches – hierarchical agglomerative clustering, k-means (Lloyd's algorithm), – DBSCAN – Relative merits of each method – clustering tendency and quality.

UNITV DATA VISUALIZATION

9

Acquiring and Visualizing Data – Applications of Data Visualization – Keys factors of Data Visualization – Exploring the Visual Data Spectrum: charting Primitives, Exploring advanced Visualizations. Making use of HTML5 CANVAS, Integrating SVG – Reading Data from Standard text files (.txt, .csv, XML), Displaying JSON content Outputting Basic Table Data – Assuring Maximum readability – Including computations, Using data tables library, relating data table to a chart.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1** Utilize EDA, inference and regression techniques

CO2	Utilize Matrix decomposition techniques to perform data analysis
CO3	Apply data pre-processing techniques.
CO4	Apply Basic Machine Learning Algorithms
CO5	Apply data visualization in big-data analytics
CO6	Using data tables library.

TEXT BOOKS:

- 1 Joel Grus, “Data Science from Scratch: First Principles with Python”, O’Reilly Media, 2015.
- 2 Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly Media, 2012

REFERENCE BOOKS:

- 1 Cathy O’Neil and Rachel Schutt, “ Doing Data Science, Straight Talk From The Frontline”, O’Reilly, 2014
- 2 Jiawei Han, Micheline Kamber and Jian Pei, “ Data Mining: Concepts and Techniques”, Third Edition. ISBN 0123814790, 2011
- 3 Mohammed J. Zaki and Wagner Miera Jr, “Data Mining and Analysis: Fundamental Concepts and Algorithms”, Cambridge University Press, 2014
- 4 Matt Harrison, “Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization , O’Reilly, 2016.

COURSE OBJECTIVES

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

- 1 Understand the fundamentals of Internet of Things
- 2 Study the IoT architecture and design models
- 3 Explain the evolving computer model caned cloud computing.
- 4 Introduce the various levels of services that can be achieved by cloud.
- 5 Describe the different types of Migration services & Data Storage

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 **ISBN: 9781484220474**
- 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).

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.

UNIT V PATENTS**9**

Patents – COURSE OBJECTIVES and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, 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

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

Definition of Microservices–Characteristics–Microservices and Containers–Interacting with Other Services–Monitoring and Securing the Services–Containerized Services–Deploying on Cloud

UNIT II MICROSERVICES ARCHITECTURE

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 –TestNG – User Acceptance Testing – Jenkins

UNIT IV MICROSERVICES IN 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

UNIT V VELOCITY AND CONTINUOUS DELIVERY

9

Velocity–Delivery Pipeline–test stack–Small/Unit Test–medium/integration testing– system testing– Job of Development and DevOps–Job of Test and DevOps–Job of Ops and 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 used in 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 James A Scott, A Practical Guide to Microservices and Containers, MapR Data Technologies e-book. <https://mapr.com/ebook/microservices-and-containers/assets/microservices-and-containers.pdf>
- 2 Joyner Joseph, Devops for Beginners ,First Edition, Mihails Konoplov publisher, 2015.

REFERENCE BOOKS:

- 1 Namit Tanasseri, Rahul Rai, Microservices with Azure, 1st Edition, Packt Publishing, UK, 2017
- 2 Eberhard Wolff, Microservices: Flexible Software Architecture, 1st Edition, Pearson Education, 2017
- 3 James A Scott, A Practical Guide to Microservices and Containers, MapR Data Technologies e-book.
<https://mapr.com/ebook/microservices-and-containers/assets/microservices-and-containers.pdf>
- 4 Joyner Joseph, Devops for Beginners, First Edition, Mihails Konoplov publisher, 2015.

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 - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing

UNIT V 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 Certified 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.

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 ,Jao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016.
- 4 Xin-She Yang, "Nature Inspired Optimization Algorithm,Elsevier First Edition 2014.

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. Optimization for 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 and Meta-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.

UNIT V 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.

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 and analyze the protocols for IPv6 Implementation
- 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

IPv4 Address Depletion–IPv6 Transition Issues–IPv6 Structure: IPv6 Header, Extension Headers: Hop–by–Hop Options Header, Destination Options Header, Routing Header, Fragment Header, AH, ESP–IPv6 Addresses: Unicast, Anycast, 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, PROVISIONING AND SECURITY WITH IPv6 9

QoS in IPv6 Protocols: Differentiated Services and IPv6, IPv6 Flows, Explicit Congestion Notification in IPv6 – Provisioning: Stateless DHCPv6, 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.

UNIT V NETWORK FUNCTION VIRTUALIZATION 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 | Describe how IPv6 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.

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 Theoretic Models–Probabilistic Models–Algebraic Models–Structured Text Retrieval Models–Models for Browsing.

UNIT III INDEXING**9**

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching–Sequential Searching and Pattern Matching. Query Operations–Query Languages–Query Processing–Relevance Feedback and Query Expansion–Automatic Local and Global Analysis–Measuring Effectiveness and Efficiency.

UNIT IV CLASSIFICATION AND CLUSTERING**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.

UNIT V SEARCHING THE WEB AND 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 Ricardo Baeza-Yates, Berthier Ribeiro-Neto, —Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition, 2011
- 2 Stefan Butcher, 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 Edition 2010.
- 2 Manning D. Christopher, Raghavan Prabhakar & Schutz Hinrich, “Introduction to Information Retrieval”, Cambridge University Press, Online Edition, 2009.
- 3 David A. Grossman, Ophir Frieder, “Information Retrieval: Algorithms and Heuristics”, Springer, 2nd Edition, 2004
- 4 Bruce Croft, Donald Metzler, Trevor Strohman, “Search Engines: Information Retrieval in Practice”, Pearson, 2009.

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 every where– 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.
Royle, J.,& Laing, A.(2014).The digital marketing skills gap: Developing a Digital Marketer
- 4 Model for the communication industries. International Journal of Information Management,34(2),65–73

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.

UNIT V 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”, 2nd Edition ,Sage Publications, India, 2019.
- 2 Claus O . Wilke, “Fundamentals of DataVisualization”, 1st Edition ,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", 1st Edition ,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", 1st Edition, O'Reilly, 2013

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.

UNIT V 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.

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

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 Moraes 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.

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 | Perform various operations on numpy arrays. |
| CO2 | Importing data from different file formats using pandas. |
| CO3 | Draw different types of charts using matplotlib. |
| CO4 | Analyze the Correlation and Covariance. |
| CO5 | Understand the Visualizations and formats |
| CO6 | Understand the basic Statistical and Probability measures for data science. |

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 Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.
- 2 Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine
- 3 Launch and configure the virtual machine in AWS cloud.
- 4 Study of different operating systems for Raspberry Pi / Beagle board. Understanding the process of Os installation on Raspberry – Pi/ Beagle board
- 5 Show the virtual machine migration based on the certain condition from one node to the other.
- 6 Find procedure to install storage controller and interact with it
- 7 Familiarization with the concept of IOT, Arduino / Raspberry Pi and perform necessary software installation.
- 8 Study of Connectivity and Configuration of Raspberry–Pi/ Beagle Board circuit with basic peripherals, LEDs, Understanding GPIO and its use in program.
- 9 High Speed Internet, Projector, White Board, Intercom
- 10 Potentiometer And Ir Sensor Interfacing With Arduino
- 11 Controlling Two Actuators Using Arduino
- 12 Creation of Things Speak Account
- 13 Actuator Controlling Through Cloud
- 14 Iot Based Air Pollution Control System

TOTAL: 60 PERIODS**LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS**

Sl no	Name of the Equipment	Quantity
1	Familiarization with the concept of IOT, Arduino / Raspberry Pi and perform necessary software installation	
2	Arduino/ Raspberry Pi, and also able to install software setup of Arduino/ Raspberry Pi.	
3	Arduino basic kit or Raspberry Pi starter kit.	
4	Can be installed on LINUX and a stripped down IOT version of Windows10.	
5	Raspberry Pi / Beagle board. Understanding the process of Os installation on Raspberry – Pi/ Beagle board	
6	Raspberry Pi starter kit	
7	Unit of Beagle board	
7	Windows 7 64 bit or higher/ Ubuntu 16.04 or higher, Raspberry Pi desktop RASBIAN	
8	RTOS-Realtime Operating System Sun Solaris BSD	

- 9 Embedded Linux
- 10 Desktop Linux
- 11 Embedded Windows
- 12 Desktop Windows
- 13 Roll your own or in-house
- 14 UNIX

COURSE OUTCOMES:

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

- C01** Implement interfacing of various sensors with Arduino/Raspberry Pi.
- C02** Demonstrate the ability to transmit data wirelessly between different devices.
- C03** Show an ability to upload/download sensor data on cloud and server.
- C04** Examine various SQL queries from MySQL database.
- C05** Understand the concept of Internet of Things.
- C06** Understand the software installation.

LIST OF OPEN ELECTIVE FOR PG PROGRAMMES

SEMESTER III

P23CA01	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				
UNIT I	CONTEXT FOR IWRM				
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.		9			
UNIT II	WATER ECONOMICS				
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.		9			
UNIT III	LEGAL AND REGULATORY SETTINGS				
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– International law for groundwater management– World Water Forums– Global Water Partnerships– Development of IWRM in line with legal and regulatory framework.		9			
UNIT IV	WATER AND HEALTH WITH IN THE IWRM CONTEXT				
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.		9			
UNIT V	AGRICULTURE IN THE CONCEPT OF IWRM				
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.		9			

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 pros and 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:

- Technical Advisory Committee–
- 1 Effective Water Governance”. Technical Advisory Committee Background paper No: 7. Global water partnership–Stockholm–Sweden– 2003
- 2 Mollinga .P. et al “ Integrated Water Resources Management”– Water in South Asia Volume I– Sage Publications–2006.

REFERENCES

- 1 Cech Thomas V.– Principles of water resources: history– development– management and policy. John Wiley and Sons Inc.–New York. 2003
- 2 Mollinga .P. et al “ Integrated Water Resources Management”– Water in South Asia Volume I–Sage Publications–2006
- 3 Technical Advisory Committee–Integrated Water Resources management– Technical Advisory Committee Background Paper No: 4 Global water partnership–Stockholm–Sweden. 2002
- 4 Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management– Technical Advisory Committee Background paper No: 3 Global water partnership– Stockholm–Sweden. 1999.

COURSE OBJECTIVES:

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

UNIT I 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

UNIT II 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.

UNIT III CHALLENGES INMANAGEMENTANDDEVELOPMENT**9**

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

UNIT IV GOVERNANCE**9**

Public health–Community Health Assessment and Improvement Planning(CHA/CHIP)– Infrastructure and Investments on Water–(WASH)–Cost Benefit Analysis– Institutional Intervention– Public Private Partnership–Policy Directives–Social Insurance– Political Will vs Participatory Governance.

UNIT V INITIATIVES**9**

Management vs Development–Accelerating Development – Development Indicators– 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 of fundamental concepts and terms which are to be applied and understood All through the study.
- CO2** Comprehend the various factors affecting water sanitation and health through the lens of third world scenario.
- CO3** Critically analyse and articulate the 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** Gain an overarching insight into the aspects of sustainable resource management in 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 Publishers www.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.83
- 3 Improving the Environment for learning: An Expanded Agenda National Research Council. *Global Issues in Water–Sanitation– and Health: Workshop Summary*. Washington–DC: The National Academies Press–2009.
- 4 Sen– Amartya 1997. On Economic Inequality. Enlarged edition– with annex by James Foster and Amartya Sen–Oxford: Clarendon Press–1997.

COURSE OBJECTIVES

- 1 Economical 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 analysing sustainability.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES**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.

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
- 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.*

P23CA04 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 IDENTIFICATION AND PREDICTION**10**

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

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 familylevel impacts. communities in transition–rehabilitation.

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN**9**

Environmental management plan – preparation– implementation and review – mitigation andrehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmentalimpact 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

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 intensityand sound pressure level – Addition– subtraction and averaging decibel levels – sound spectra –Types of soundfields – Octave band analysis – Loudness.

UNIT– III INSTRUMENTATION FOR VIBRATION MEASUREMENT**9**

Experimental Methods in Vibration Analysis.– Vibration Measuring Instruments – Selectionof 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 – Recordingof 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 noisesources 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 reductionVs 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 –Hill Publishing 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

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

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

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”– Third edition– World Scientific Publishers– 2010.
- 2 Amit Bandyopadhyay and Susmita Bose– “Additive Manufacturing”– 1st Edition– CRC Press.– United States– 2015– ISBN–13: 978–1482223590

REFERENCES

- 1 Andreas Gephhardt 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 Bandyopadhyay and Susmita Bose– “Additive Manufacturing”– 1st Edition–CRC Press.–United States– 2015– ISBN–13: 978–1482223590
- 4 Andreas Gebhardt– “Understanding Additive Manufacturing: Rapid Prototyping– Rapid Manufacturing”– Hanser Gardner Publication– Cincinnati.– Ohio– 2011– ISBN :9783446425521

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 ARCHITECTURE

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 equation of 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 equation of 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 and Fuel 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 and Design”– CRC Press– 2005

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 Applying the principles of Industrial design and prototype for new product design and development.

UNIT I	INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT	9
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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 IDENTIFICATION & PRODUCT PLANNING	9
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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
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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
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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
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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 newproduct design anddevelopment.
- 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 newproducts.
- 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– CRCPress–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

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 pillars in sustainability management

UNIT I	MANAGEMENT OF SUSTAINABILITY	9
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Management of sustainability –rationale and political trends: An introduction to sustainability management– International and European policies on sustainable development– theoretical pillars in sustainability management studies.

UNIT II	CORPORATE SUSTAINABILITY AND RESPONSIBILITY	9
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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
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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
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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
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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 and minimizing environmental impacts while achieving the expected social impact. |
| 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 Emerging trends 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: Principles and Practice– 2014
- 4 Margaret Robertson– Sustainability Principles and Practice– 2014

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** Familiarise 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.

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 toWIPO– 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 Bookcompany.
- 4 Edited by Derek Bosworth and Elizabeth Webster– The Management ofIntellectual Property–Edward Elgar Publishing Ltd.– 2006.

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 MANAGEMENT**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
 BradAgle–AaronMiller–BillO’Rourke–
- 2 TheBusinessEthicsFieldGuide:theessentialcompanion to leading your career andyourcompany–
 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.

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– IoTstandards– 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: WiFi (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 withRASPERRY PI and Arduino.

UNIT V CASE STUDIES

9

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

COURSE OUTCOMES

TOTAL: 45 PERIODS

- | | |
|------------|---|
| CO1 | Analyze the concepts of IoT and it present developments. |
| CO2 | Compare and contrast different platforms and infrastructures available forIoT |
| 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:

The Next Internet” Morgan Kuffmann Publishers– 2010.

REFERENCES

- 1 Arshdeep Bahga and Vijai Madisetti A Hands-on Approach “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.

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– Adaline– Standard Back propagation Training Algorithms for Pattern Association – Hebb rule and Delta rule– Hetero associative– Auto associative– Kohonen Self Organising 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– Autoencoders: Convolutional Autoencoders– Denoising autoencoders– Variational autoencoders– GANs: The discriminator– generator– DCGANs

COURSE OUTCOMES

TOTAL : 45 PERIODS

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.

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 C and Type D Configurations– Grid connectionIssues – 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.

COURSE OUTCOMES**TOTAL : 45 PERIODS**

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 point tracking 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 University Press–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 and Applications”– PHI Learning Private Limited– 2012

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– Basics of 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 SmartGrid.
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

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 AnalyticsPlatform(RTAP) Applications – Case Studies – Real Time Sentiment Analysis– Stock Market Predictions

UNIT IV FRAMEWORKS**9**

MapReduce – 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– Stringmanipulations

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 thebusinessoutcome.
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 Matloff– 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

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– CloudData 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 of Things–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

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 Actuator 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– First edition– 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

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 –
Electricity Usage 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 Press Cambridge– 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 and Interfacing"– Morgan & Claypool Publishers– 2012
- 4 Mike Riley– "Programming Your Home – Automate With Arduino– Android and Your Computer"– the Pragmatic Programmers– Llc– 2012

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 Sustainability Policy: 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 BusinessLandscape– 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

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 Fibre 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– specific gravity of composites– tensile– flexural– impact– compression– inter laminar shear stress and fatigue properties of thermoset andthermoplastic composites.

UNIT V MECHANICS

9

Micro mechanics– macro mechanics of single layer– macro mechanics of laminate– classicallamination 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 | fibres and its properties |
| CO3 | Optimization of matrices |
| CO4 | Methods of composites manufacturing for both thermo plastics and thermo 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.

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 titaniumoxide – Colour cosmetics. Nanotechnology in Food Technology – Nanopackaging 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 Veprjek (Review Article) JVST
Nanometer versus micrometer–sized particles–Christian Brosseau– Jamal BeN Youssef–
- 2 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.

COURSE OBJECTIVES:

- 1 Application preparation filing and prosecution
- 2 Forms and fees Invention in context of “prior art”
- 3 Introduction to existing schemes Patent 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–espacenet(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 – Bio safety Levels – Biosafety Levels of Specific Microorganisms – Recommended Bio safety Levels for Infectious Agents and Infected Animals – Bio safety 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 Programmes (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.

COURSE OUTCOMES:

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

- CO1** National Regulations and relevant International Agreements including Cartagena 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.