ADHIYAMAAN COLLEGE OF ENGINEERING, (Autonomous), **HOSUR**

Department of Computer Science and Engineering

M.E.-Computer Science and Engineering

Curriculum for Regulation 2022 -CBCS

(Applicable to students admitted from the Academic year 2022-2023 onwards)

SEMESTER- 1

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	FC	122MCT01	Applied Probability and Statistics	3	1	0	4	40	60	100
2	PC	122MCT02	Advanced Data Structures and Algorithms	3	1	0	4	40	60	100
3	PC	122MCT03	Advanced Database Management Systems	3	0	0	3	40	60	100
4	PC	122MCT04	Software Requirement Engineering	3	0	0	3	40	60	100
5	PC	122MCT05	Foundations of Data Science	3	0	0	3	40	60	100
6	RM	122RMT06	Research Methodology and IPR	3	0	0	3	40	60	100
7	AC	X22GATxx	Audit Course - I	2	0	0	0	40	60	40
PRACTICALS										
8	PC	122MCP07	Advanced Data Structures And Algorithms Laboratory	0	0	2	1	60	40	100
9	PC	122MCP08	Advanced Database Management systems Laboratory	0	0	2	1	60	40	100
			TOTAL MANDATORY CREDITS				**22**			

SEMESTER-II

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PC	222MCT01	Advanced Operating System	3	0	0	3	40	60	100
2	PC	222MCT02	Machine Learning Techniques	3	0	0	3	40	60	100
3	PC	222MCT03	Network Technologies and Protocols	3	0	0	3	40	60	100
4	PE	X22MCExx	Professional Elective – I	3	0	0	3	40	60	100
5	PE	X22MCExx	Professional Elective – II	3	0	0	3	40	60	100
6	OE	X22XXOxx	Open Elective	3	0	0	3	40	60	100
7	AC	X22GATxx	Audit Course -II	2	0	0	0			
PRACTICALS										
8	EEC	222MCP07	Term Paper and Seminar	0	0	2	1	60	40	100
9	PC	222MCP08	Machine Learning Techniques Laboratory	0	0	2	1	60	40	100
			TOTAL MANDATORY CREDITS				**20**			

SEMESTER-III

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PC	322MCT01	Principles of Modern Cryptography	3	0	0	3	40	60	100
2	PC	322MCT02	Internet of Things	3	0	0	3	40	60	100
3	PE	X22MCExx	Professional Elective – **III**	3	0	0	3	40	60	100
4	PE	X22MCExx	Professional Elective –**IV**	3	0	0	3	40	60	100
PRACTICALS										
5	EEC	322MCP05	Project Work Phase-I	0	0	12	6	40	60	100
			TOTAL MANDATORY CREDITS				**18**			

SEMESTER-IV

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
PRACTICALS										
1	EEC	422MCP01	Project Work Phase -II	0	0	24	12	40	60	100
TOTAL MANDATORY CREDITS							**12**			

AUDIT COURSES (AC)
Registration for any of these courses is optional to students

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	CA		
								CA	EA	TOT
1	AC	X22GAT01	English For Research Paper Writing	2	0	0	0	60	40	100
2	AC	X22GAT02	Disaster Management	2	0	0	0	60	40	100
3	AC	X22GAT03	Constitution Of India	2	0	0	0	60	40	100
4	AC	X22GAT04	நற்றமிழ் இலக்கியம்	2	0	0	0	60	40	100

PROFESSIONAL ELECTIVES - DOMAIN- 1 (NETWORKS)

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE11	Ad-Hoc Network	3	0	0	3	40	60	100
2	PE	X22MCE12	Wireless Sensor Nework	3	0	0	3	40	60	100
3	PE	X22MCE13	Distributed Systems	3	0	0	3	40	60	100
4	PE	X22MCE14	Cloud Computing	3	0	0	3	40	60	100
5	PE	X22MCE15	Cyber Physical Systems	3	0	0	3	40	60	100
6	PE	X22MCE16	High Performance Computing for Big Data	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES - DOMAIN -II (SECURITY)

S.No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE21	Cyber Security	3	0	0	3	40	60	100
2	PE	X22MCE22	Crypto Currency & Blockchain Technologies	3	0	0	3	40	60	100
3	PE	X22MCE23	Ethical Hacking	3	0	0	3	40	60	100
4	PE	X22MCE24	Security and Privacy in Cloud	3	0	0	3	40	60	100
5	PE	X22MCE25	Computer Forensics	3	0	0	3	40	60	100
6	PE	X22MCE26	Bioinformatics	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES - DOMAIN- 1II (ARTIFICIAL INTELLIGENCE)

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE31	Artificial Intelligence Principles And Techniques	3	0	0	3	40	60	100
2	PE	X22MCE32	Soft Computing Techniques	3	0	0	3	40	60	100
3	PE	X22MCE33	Knowledge Engineering And Expert Systems	3	0	0	3	40	60	100
4	PE	X22MCE34	Cognitive Computing	3	0	0	3	40	60	100
5	PE	X22MCE35	Natural Language Processing	3	0	0	3	40	60	100
6	PE	X22MCE36	Speech Processing	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES - DOMAIN- 1V (BIG DATA)

S.No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE41	Data Mining Technologies	3	0	0	3	40	60	100
2	PE	X22MCE42	Big Data Analytics	3	0	0	3	40	60	100
3	PE	X22MCE43	Deep Learning	3	0	0	3	40	60	100
4	PE	X22MCE44	Social Network Analysis	3	0	0	3	40	60	100
5	PE	X22MCE45	Reinforcement Learning	3	0	0	3	40	60	100
6	PE	X22MCE46	Data Visualization	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES - DOMAIN- V (IMAGE PROCESSING)

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE51	Digital Image Processing	3	0	0	3	40	60	100
2	PE	X22MCE52	Multimedia Coding Techniques	3	0	0	3	40	60	100
3	PE	X22MCE53	Computer Vision	3	0	0	3	40	60	100
4	PE	X22MCE54	Pattern Recognition	3	0	0	3	40	60	100
5	PE	X22MCE55	Video Analytics	3	0	0	3	40	60	100
6	PE	X22MCE56	Principles of Sensors	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVES - DOMAIN- VI (SOFTWARE ENGINEERING)

S.No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE61	Advanced Software Engineering	3	0	0	3	40	60	100
2	PE	X22MCE62	Software Test Automation	3	0	0	3	40	60	100
3	PE	X22MCE63	Software Security	3	0	0	3	40	60	100
4	PE	X22MCE64	Integrated Software Project Management	3	0	0	3	40	60	100
5	PE	X22MCE65	Software Reliability Metrics & Modelling	3	0	0	3	40	60	100
6	PE	X22MCE66	Software Verification And Validation	3	0	0	3	40	60	100

Summary of Credit Distribution

S. NO.	SEMESTER	CREDITS
1	I	22
2	II	20
3	III	18
4	IV	12
TOTAL		**72**

SEMESTER- 1

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	FC	122MCT01	Applied Probability and Statistics	3	1	0	4	40	60	100
2	PC	122MCT02	Advanced Data Structures and Algorithms	3	1	0	4	40	60	100
3	PC	122MCT03	Advanced Database Management Systems	3	0	0	3	40	60	100
4	PC	122MCT04	Software Requirement Engineering	3	0	0	3	40	60	100
5	PC	122MCT05	Foundations of Data Science	3	0	0	3	40	60	100
6	RM	122RMT06	Research Methodology and IPR	3	0	0	3	40	60	100
7	AC	X22GATxx	Audit Course - I	2	0	0	0	40	60	100
PRACTICALS										
8	PC	122MCP07	Advanced Data Structures And Algorithms Laboratory	0	0	2	1	60	40	100
9	PC	122MCP08	Advanced Database Management systems Laboratory	0	0	2	1	60	40	100
			TOTAL MANDATORY CREDITS				**22**			

122MCT01 APPLIED PROBABILITY AND STATISTICS L T P C
3 1 0 4

COURSE OBJECTIVES:

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

UNIT I LINEAR ALGEBRA 9+3

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

UNIT II PROBABILITY AND RANDOM VARIABLES 9+3

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

UNIT III TWO DIMENSIONAL RANDOM VARIABLES 9+3

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

UNIT IV TESTING OF HYPOTHESIS 9+3

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

UNIT V MULTIVARIATE ANALYSIS 9+3

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

TOTAL: 45+15 = 60

PERIODS

COURSE OUTCOMES:

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

CO 1. apply the concepts of Linear Algebra to solve practical problems.
CO 2. use the ideas of probability and random variables in solving engineering problems.
CO 3. be familiar with some of the commonly encountered two dimensional random variables
CO 4. use statistical tests in testing hypotheses on data.
CO 5. apply the concepts of multivariate normal distribution and principal components analysis.

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REFERENCES:

1. Dallas E Johnson, “Applied multivariate methods for data Analysis”, Thomson and Duxbury press, Singapore, 1998.
2. Richard A. Johnson and Dean W. Wichern, “Applied multivariate statistical Analysis”, Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
3. Bronson, R.,”Matrix Operation” Schaum’s outline series, Tata McGraw Hill, New York, 2011.
4. Oliver C. Ibe, “Fundamentals of Applied probability and Random Processes”, Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson India Education, Asia, 9th Edition, New Delhi, 2017

CO’s-PO’s & PSO’s MAPPING:

122MCT01 - Applied Probability and Statistics															
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	-	-	-	-	-	-	-	-	2	2	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	2	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	2	2	-
CO5	3	3	3	2	-	-	-	-	-	-	-	2	2	2	-
AVG	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**-**

1 – Low, 2 – Medium, 3 – High, “- “– No Correlation

122MCT02 ADVANCE DATA STRUCTURES AND ALGORITHM L T P C

3 1 0 4

OBJECTIVE(S):

- To select and design data structures and algorithms that is appropriate for problems
- To learn and use hierarchical data structures and its operations
- To understand the usage of algorithms in computing

UNIT-I ALGORITHM DESIGN TECHNIQUES 9

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Dynamic Programming: Matrix-Chain Multiplication – Overlapping sub problem– Longest Common Subsequence- Reliability design problem - Convex Hull- Greedy Algorithms: Boyer-Moore pattern matching algorithm-An Activity Selection Problem - Huffman Coding.

UNIT - II TREE STRUCTURES 9

Binary Search Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries - k-d Trees - Range Trees –Segment tree- Voronoi Diagram.

UNIT - III HEAP STRUCTURES 9

Heaps- Heap Implementation –Disjoint sets- Min/Max heaps- Binary Heaps– Leftist Heaps – Binomial Heaps- Skew Heaps – Lazy-Binomial Heaps – Fibonacci Heaps: Structure Mergeable heap operations – Decreasing a node - Bounding the maximum degree.

UNIT-IV ROLE OF ALGORITHMS IN COMPUTING 9

Asymptotic analysis-Average and worst-case analysis-Asymptotic notation- Properties of Big-oh Notation – Conditional Asymptotic Notation - Introduction to NP-Completeness/NP-Hard. Recurrences & Non Recurrences: The Substitution Method – The Recursion-Tree Method- Master Solving Method – Probalistic analysis and Random analysis.

UNIT V PARALLEL ALGORITHMS 9

Flynn's Classifications – List Ranking – Prefix computation – Array Max – Sorting on EREW PRAM Sorting on Mesh and Butterfly – Prefix sum on Mesh and Butterfly – Sum on mesh and butterfly – Matrix Multiplication Data Distribution on EREW, Mesh and Butterfly**.**

TOTAL: 45 Hours

COURSE OUTCOMES:

At the end of the course student should be able to

CO1: Design data structures and algorithms to solve computing problems.

CO2: Choose and implement efficient tree strategies and apply them to solve problems.

CO3: Implement efficient heap structures and apply them to solve problems.

CO4: Master a variety of advanced data structures and their implementations and different algorithm design techniques in computational geometry and in parallel algorithms

CO5: Apply suitable design strategy for problem solving.

REFERENCE BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 6th Edition, 2020.

E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2015.

2. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures in C", Silicon Pr, 2009.
3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, "Computational Geometry Algorithms and Applications", Third Edition, 2008.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 2009.

CO's-PO's & PSO's MAPPING:

122MCT02 - Advanced Data Structures and Algorithms															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	2	-	2	-	-	-	-		-	3	-	3	2
CO2	-	3	2	-	2	-	-	-	-	-	-	3	-	3	2
CO3	-	3	2	3	2	-	-	-	-	-	-	3	-	3	2
CO4	-	3	2	2	1	-	-	-	-	-	-	2	-	3	2
CO5	-	3	2	3	1		-	-	-	-	-	3	-	3	2
AVG	**-**	**3**	**2**	**2.6**	**1.6**	-	**-**	**-**	**-**	**-**	**-**	**2.8**	**-**	**3**	**2**

1 – Low, 2 – Medium, 3 – High, "-" – No Correlation

122MCT03 ADVANCE DATABASE MANAGEMENT SYSTEMS L T P C
3 0 0 3

Course Objectives

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study Object Oriented, Parallel database design and the Distributed Database Design
- To have an introductory knowledge about the Query processing and Query optimization Techniques

UNIT – I INTRODUCTION 9

History of Database Systems. Data base System Applications, data base System VS file System; Data Models: ER Model, relational model, other models; Database Languages: DDL, DML; Introduction to the Relational Model: Integrity constraint over relations, Enforcing integrity constraints, querying relational data, logical data base design; Introduction to Views: Destroying, altering tables and views; Introduction of object database systems: Structured data types, operations on structured data, encapsulation and ADTS, Inheritance.

UNIT – II ORDBMS 9

Database design for ORDBMS, ORBMS implementation and challenges, OODBMS, comparison of RDBMS, OODBMS and ORDBMS. Introduction to Parallel databases, architectures for parallel databases, Parallel Query Evaluation: Data partitioning and parallelizing sequential operator evaluation code, parallelizing individual operations, and parallel query optimization.

UNIT – III IDISTRIBUTED DATABASES & DESIGN 9

Introduction to distributed databases: Features of distributed databases vs centralized databases, Why distributed databases. DDBMS: Levels of transparency, reference architecture for DDB, types of data fragmentation, distribution transparency for read-only and update applications, distributed database access primitives, Integrity constraints in distributed databases.Distributed database design - allocation of fragments; Distributed Query processing distributed grouping and aggregation functions, parametric queries.

UNIT – IV QUERY OPTIMIZATION 9A

framework for query optimization, join queries and general queries. non-join queries in a distributed DBMS, joins in a distributed DBMS, cost based query optimization. DBMS Vs IR systems, Introduction to Information retrieval, Indexing for text search, web search engine, managing text in a DBMS, a data model for XML, Querying XML data, and efficient \evaluation of XML queries.

UNIT – V ADVANCED DATABASE MODELS AND SECURITY 9

Active Databases - Temporal Databases - Spatial Databases - Multimedia Databases - Deductive Databases – NoSQL Databases. Security: Discretionary Access Control- Mandatory Access Control - Role-based Access Control - SQL injection - Challenges of Database Security.

Total: 45 periods

Course Outcomes

Upon Completion of this course, students should be able to

CO1: Map ER model to Relational model to perform database design effectively
CO2: Design different types of databases
CO3: Compare and contrast various indexing strategies in different database systems
CO4: Use different query optimization techniques
CO5: Use different database models

REFERENCE BOOKS:

1. Raghuramakrishnan and Johannes Gehrke, “Database Management Systems”, 3rd Edition, TMH, 2014.
2. S Ceri and G Pelagatti, “Distributed databases principles and systems”, 1st Edition, TMH, 2017.
3. Silberschatz, Korth, “Database System Concepts”, 6th Edition, TMH, 2013.
4. Elmasri R, Navathe S B, Somayajulu D V L N, and Gupta S K, “Fundamentals of Database Systems”, 7th Edition, Pearson Education, 2015.
5. C. J. Date, “Introduction to Database Systems”, 8th Edition, Pearson Education, 2009
6. Pramod J. Sadalage and Martin Fowler, “NoSQL Distilled- A Brief Guide to the Emerging world of Polyglot Persistence”, Pearson Education, 2013

CO’s-PO’s & PSO’s MAPPING:

122MCT03 - Advanced Database Management Systems															
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
AVG	-	-	2	1	-	-	-	-	-	-	-	-	2	--	2

1 – Low, 2 – Medium, 3 – High, “-“ – No Correlation

122MCT04 SOFTWARE REQUIREMENT ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- Understand the basics of requirements engineering.
- Learn different techniques used for requirements elicitation.
- Know the role played by requirements analysis in requirement integration.
- Appreciate the use of various methodologies for requirementis development.
- Study the current trends in requirements prioritization and validation.

UNIT I REQUIREMENTS ENGINEERING OVERVIEW 9

Software Requirement Overview - Software Development Roles -Software Development Process Kernels - Commercial Life Cycle Model - Vision Development - Stakeholders Needs & Analysis - Stakeholder needs - Stakeholder activities–Requirement Capture and Modelling-Requirement Analysis.

UNIT II REQUIREMENTS ELICITATION 9

The Process of Requirements Elicitation - Requirements Elicitation Problems - Current Elicitation Techniques - Information Gathering - Requirements Expression and Analysis - Validation - An Elicitation Methodology Framework - A Requirements Elicitation Process Model - Methodology over Method - Integration of Techniques - Fact-Finding - Requirements Gathering - Evaluation and Rationalization - Prioritization- Integration and Validation - Risk Assessment and Risk Treatment (RART).

UNIT III REQUIREMENTS ANALYSIS 9

Identification of Functional and Non Functional Requirements - Requirement Engineering -Requirement Elicitation and Analysis - Requirements Management -Identification of Quality Requirements - Six Quality Attributes- Analysis - Feasibility and Internal Compatibility of System Requirements -Human Requirements Baseline.

UNIT IV REQUIREMENTS DEVELOPMENT 9

Requirements analysis - Requirements Documentation - Requirements Development Workflow -Fundamentals of Requirements Development - Requirements Attributes Guidelines Document -Supplementary Specification Document - Use Case Specification Document - Methods for Software Prototyping - Evolutionary prototyping - Throwaway prototyping.

UNIT V REQUIREMENTS VALIDATION AND VERIFICATION 9

Validation objectives - Analysis of requirements validation - Activities - Properties Requirement reviews - Requirements testing - ISO 31000 - Testing Fundamentals Test Plan- Test Design- Test Execution- Reviews- Inspection Auditing- Case tools for requirements engineering

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Prepare SRS including the details of requirements engineering.

CO2: Describe the stages of requirement elicitation.

CO3: Analyze software requirements gathering.

CO4: Integrate the requirements well during requirements analysis.

CO5: Use various methodologies for requirements validation and verification

REFERENCES:

1. Phillip A.Laplante, Mohamad H.Kassab ,-Requirement Engineering for Software and Systems-Fourth Edition, 2022
2. Wiegers, Karl,Joy Beatty, -Software Requirements-, Pearson Education,2013.
3. Ian Sommerville, Pete Sawyer,- Requirements Engineering: A Good Practice Guide-, Sixth Edition, Pearson Education, 2004.
4. Dean Leffingwe, DonWidrig, -Managing Software Requirements AUseCaseApproach-, Second Edition, Addison Wesley,2003.
5. Karl Eugene Wiegers, -Software Requirements-, Word Power Publishers, 2000.
6. Ian Graham, -Requirements Engineering and Rapid Development-, AddisonWesley,1998.

CO's-PO's & PSO's MAPPING:

122MCT04 - Software Requirement Engineering															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	-	-	1	2	-	-	-	-	1	-	-	-	-
CO2	2	1	-	1	-	2	-	-	-	-	1	-	-	-	-
CO3	2	-	-	1	1	-	-	-	-	-	1	-	-	-	-
CO4	1	2	-	1	1	-	-	-	-	-	2	-	-	-	-
CO5	-	1	-	2	2	1	-	-	-	-	-	-	-	-	-
AVG	**1.75**	**1.25**	-	**1.25**	**1.25**	**1.67**	-	-	-	-	**1.25**	-	-	-	-

1 – Low, 2 – Medium, 3 – High, "- "– No Correlation

122MCT05 **FOUNDATIONS OF DATA SCIENCE** **L T P C**
3 0 0 3

OBJECTIVE(S):

- To understand the important steps in drawing useful conclusions from data
- To ask appropriate questions about data after data exploration using visualization and descriptive statistics
- To apply machine learning and optimization techniques to make predictions
- To correctly interpret the answers generated by inferential and computational tools

UNIT– I INTRODUCTION TO DATA SCIENCE **9**

Data science process – roles, stages in data science project – working with data from files –working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation

UNIT– II MODELING METHODS **9**

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm – Memorization Methods – Linear and logistic regression – unsupervised methods.

UNIT– III EXPLORATORY DATA ANALYSIS AND HYPOTHESIS TESTING **9**

Exploratory Data Analysis: Central Tendency, Dispersions, Five number Distributions, Cross Tabulations. Hypothesis Testing: Confidence Intervals, Constructing a hypothesis, Null Hypothesis & Alternative Hypothesis, Type I and Type II errors, Parametric test: Z test, One Sample T-TEST, Paired T-TEST, Independent Sample T-TEST, ANOVA, MANOVA, Level of significance, Power of a test

UNIT– IV ESTIMATION AND PREDICTION **9**

Estimation - Resampling and Bootstrap - Confidence Intervals, Properties of Mean - Central Limit Theorem - Variability of mean -Choosing Sample Size, Prediction - Regression - Method of Least Squares - Visual and Numerical Diagnostics - Inference for true slope, Prediction intervals, Classification - Nearest neighbors - Accuracy of a classifier

UNIT– V APPLICATIONS OF DATA SCIENCE **9**

Applications of Data Science, Technologies for visualization, Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science

TOTAL: 45

COURSE OUTCOMES:

At the end of the course student should be able to

CO1: Learn techniques to pre-process raw data so as to enable further analysis.
CO2: Conceptualize and summarize data using appropriate data modeling approach
CO3: Conduct exploratory data analysis and create insightful visualizations to identify patterns
CO4: Apply and evaluate the degree of certainty of prediction and classification to derive insights.
CO5: To explore various applications of Data Science.

REFERENCES:

1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014
2. Allen B. Downey, Think Stats: Probability and Statistics for Programmers”, 2/e, by O’Reilly Media, 2014
3. Ani Adhikari and John DeNero,” Computational and Inferential Thinking: The Foundations of Data Science”,
   2nd Edition, UC Berkeley Division of Computing, Data Science, and Society, 2021
4. Joel Grus,” Data Science from Scratch: First Principles with Python”, 2/e, O’Reilly Media, 2019
5. Peter Bruce, Andrew Bruce and Peter Gedeck,” Practical Statistics for Data scientists: 50+ Essential
   Concepts Using R and Python”, 2/e, O’Reilly Media, 2020.
6. Cathy O’Neil and Rachel Schutt,” Doing Data Science”, O’Reilly Media, 2013
7. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011
8. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, Chapman
   and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
9. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley
   & Sons, Inc., 2012.

CO’s-PO’s & PSO’s MAPPING:

122MCT05 - Foundations of Data Science															
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	-	2	3	-	-	-	-	1	-	3	-	-	-
CO2	1	1	-	2	3	-	-	-	-	1	-	2	-	-	-
CO3	1	1	-	2	3	-	-	-	-	1	-	2	-	-	-
CO4	1	1	-	2	3	-	-	-	-	1	-	2	-	-	-
CO5	1	1	-	2	3	-	-	-	-	1	-	2	-	-	-
AVG	**1.00**	**1.00**	**-**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1**	**-**	2	-	-	-

1 – Low, 2 – Medium, 3 – High, “- “– No Correlation

122MCT06 **RESEARCH METHODOLOGY AND IPR** **L T P C**

3 0 0 3

OBJECTIVE(S):

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT - I RESEARCH METHODOLOGY: **9**

Objectives and motivation of research - Types of research - Research approaches - Significance of research - Research methods verses methodology - Research and scientific method - Importance of research methodology - Research process - Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations- Criteria of good research. Defining the research problem: Definition of research problem - Problem formulation - Necessity of defining the problem - Technique involved in defining a problem.

UNIT – II LITERATURE SURVEY AND DATA COLLECTION: **9**

Importance of literature survey - Sources of information - Assessment of quality of journals and articles - Information through internet. Effective literature studies approaches, analysis, plagiarism, and research ethics. Sampling & Methods:Data - Preparing, Exploring, examining and displaying.

UNIT – III RESEARCH DESIGN AND ANALYSIS **9**

Meaning of research design - Need of research design - Different research designs - Basic principles of experimental design - Developing a research plan - Design of experimental set-up - Use of standards and codes. 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 (IPR) **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 – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 45HOURS

COURSE OUTCOMES:

CO1: Ability to formulate research problem
CO2: Ability to carry out research and Sampling methods
CO3: Ability to follow research design and ethics
CO4: Ability to understand that today's technology, but tomorrow world will be ruled by ideas, concept, and creativity
CO5: Ability to understand about filing patents in R & D.

REFERENCES:

1. Peter S. Menell ,Mark A. Lemley, Robert P. Merges, "Intellectual Property in the New Technological "Vol. I Perspectives, 2021.
2. Laura R. Ford," The Intellectual Property of Nations: Sociological and Historical Perspectives on a Modern Legal Institution Paperback –2021.
3. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, Chennai, 2011.
4. RatanKhananabis and SuvasisSaha, "Research Methodology", Universities Press, Hyderabad, 2015.
5. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
6. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
7. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
8. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
9. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

CO's-PO's & PSO's MAPPING:

122RMT06 - Research Methodology and IPR															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	1	2	3	-	-	-	-	-	-	1	-	-	-
CO2	-	1	1	2	3	-	-	-	-	-	-	1	-	-	-
CO3	-	1	1	2	1	-	-	-	-	-	-	1	-	-	-
CO4	-	1	1	2	3	-	-	-	-	-	-	1	-	-	-
CO5	-	1	1	2	3	-	-	-	-	-	-	1	-	-	-
AVG	-	**1.4**	**1.00**	**2.00**	**2.60**	-	-	-	-	-	-	1.00	-	-	-

1 – Low, 2 – Medium, 3 – High, "-" – No Correlation

122MCP07 ADVANCE DATA STRUCTURES AND ALGORITHMS LABORATRY L T P C

0 0 2 1

OBJECTIVES:

- Toacquire theknowledge ofusingadvancedtreestructures
- Tolearn theusageofheapstructures
- Tounderstand theusageofgraphstructures and spanningtrees
- To understand the problems such as matrix chain multiplication, activity selectionandHuffman coding
- Tounderstandthenecessarymathematical abstraction tosolve problems.

PREREQUISITES : Nil

LIST OF EXPERIMENTS:

Implement the following conceptusing C++ & JAVA 30 Hours

1. ImplementationofMatrixChainMultiplication
2. Implementation of pattern matching using Boyer-Moore algorithm.
3. ActivitySelectionandHuffmanCodingImplementation
4. Implementationofa BinarySearchTree
5. ImplementationofRed-Black Tree
6. ImplementationofSplay Tree& k-d Tree
7. Implementation of Segment tree
8. Implementation of Heap
9. Implementation of Fibonacci Heap
10. ImplementationofMerge SortAnalysis and Quick Sort - Analysis

COURSE OUTCOMES:

At the end of the course student should be able to :

CO1: Designand implement basicandadvanceddatastructuresextensively

CO2: DesignalgorithmsusingTree structures

CO3: Design and develop efficient algorithms with minimum complexity using designtechniques

CO4: Develop programsusingvarious Traversal techniques.

CO5: Choose appropriate data structures and algorithms, understand the ADT/libraries,and use it to design algorithms for a specific problem.

LABREQUIREMENTS:

HARDWARE AND SOFTWARE FOR A BATCH OF 30STUDENTS

Hardware:

LAN System with 30 Nodes (OR) Stand-alone PCs -30
No's.Printer–3No's.

Software:

OS:Windows/Linu
xTurboC/C++/
JAVA

CO's-PO's & PSO's MAPPING:

122MCP07 - Advanced Data Structures And Algorithms Laboratory															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	-	2	2	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	-	2	-	-	-	-	-	-	3	-	-	-
CO4	-	3	3	2	2	-	-	-	-	-	-	3	-	-	-
CO5	-	3	2	2	1	-	-	-	-	-	-	3	-	-	-
AVG	**-**	**3.0**	**1.6**	**1.6**	**1.8**	**-**	**-**	**-**	**-**	**-**	**-**	**1.8**	**-**	**-**	**-**

1 – Low, 2 – Medium, 3 – High, "-" – No Correlation

122MCP08 **Advanced Database Management Systems laboratory** **L T P C**
0 0 2 1

PREREQUISTIES : Database Management Systems

Course Objectives :

- Tounderstand andimplementmanipulationsinDBMS
- TolearnandcreateadistributedDBMS
- TodesignaERmodelfordatabase
- Todevelopand createasearchengine

LISTOFEXERCISES:

1. ImplementationofViewsandConstraintsinDatabaseManagementSystems
2. ObjectOrientedDatabase - ERModelforUniversityDatabase
3. ParallelQueryProcessingandEvaluation-Implementation ofEfficientQueryOptimizer
4. ParallelDatabase-UniversityCounsellingForEngineeringColleges
5. DistributedDatabase ForBookStore
6. ImplementationofGroupingandAggregateFunctionsinDistributedDBMS
7. ImplementationofJoinQueriesInDistributedDBMS
8. ImplementationofNonJoinQueriesInDistributedDBMS
9. SimulationofSearchEngine
10. DesigningXMLSchemaforCompanyDatabase

Course Outcomes :

At the end of the course , the students should be able to :

CO1:Designanddevelopparallelanddistributeddatabase

CO2: Createandretrievefromdatabasewithefficientqueryoptimizer

CO3:Simulatethesearchengineusing XMLlanguage

CO4: Applyjoinoperations indistributedDBMS

CO5: Create applications with RDBMS

122MCP08-Advanced Database Management systems Laboratory															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
AVG	**-**	**-**	**3.00**	**2.00**	**-**	**-**	-	-	-	-	-	-	-	-	-

1 – Low, 2 – Medium, 3 – High, "-" – No Correlation

SEMESTER - II

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PC	222MCT01	Advanced Operating System	3	0	0	3	40	60	100
2	PC	222MCT02	Machine Learning Techniques	3	0	0	3	40	60	100
3	PC	222MCT03	Network Technologies and Protocols	3	0	0	3	40	60	100
4	PE	X22MCExx	Professional Elective – I	3	0	0	3	40	60	100
5	PE	X22MCExx	Professional Elective – II	3	0	0	3	40	60	100
6	OE	X22xxOxx	Open Elective	3	0	0	3	40	60	100
7	AC	X22GATxx	Audit Course -II	2	0	0	0	40	60	100
PRACTICALS										
8	EEC	222MCP07	Term Paper and Seminar	0	0	2	1	60	40	100
9	PC	222MCP08	Machine Learning Techniques Laboratory	0	0	2	1	60	40	100
			TOTAL MANDATORY CREDITS				**20**			

		L	T	P	C
222MCT01	**ADVANCED OPERATING SYSTEMS**	**3**	**0**	**0**	**3**

OBJECTIVE(S):

- To get a comprehensive knowledge of the architecture of distributed systems.
- To understand the deadlock and shared memory issues and their solutions in distributed Environments.
- To know the security issues and protection mechanisms for distributed environments.
- To get a knowledge of multiprocessor operating systems and database operating systems.

UNIT - I INTRODUCTION **9**

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations – inherent limitations of a distributed system – lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection. Distributed Mutual Exclusion – introduction – the classification of mutual exclusion and associated algorithms – a comparative performance analysis.

UNIT – II DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT **9**

Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems – issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed file systems – design issues – log structured file systems.

UNIT - III DISTRIBUTED SHARED MEMORY AND SCHEDULING **9**

Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing –task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent set of checkpoints – synchronous and asynchronous check pointing and recovery – check pointing for distributed database systems recovery in replicated distributed databases.

UNIT – IV DATA SECURITY **9**

Protection and security -preliminaries, the access matrix model and its implementations.-safety in matrix model- advanced models of protection. Data security – cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard-public key cryptography – multiple encryption – authentication in distributed systems.

UNIT – V MEMORY MANAGEMENT AND VIRTUAL MEMORY **9**

Introduction, Swapping, Contiguous Memory Allocation, Segmentation, Paging, structure of the Page Table. Background, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Introduction to Virtualization. Types of Virtualization Hardware Emulation, Full Virtualization with binary translation, Hardware assisted, Operating System Virtualization, OS assisted /Para virtualization.

TOTAL: 45

COURSE OUTCOMES:

CO1: Understand and explore the working of Theoretical Foundations of OS.

CO2: Analyze the working principles of Distributed Deadlock Detection and resource management.

CO3: Understand the concepts of distributed shared memory and scheduling mechanisms.

CO4: Understand and analyze the working of Data security.

CO5: Implement memory management and representing virtualization and demonstrating the various Operating System.

REFERENCES:

1. MukeshSinghal, NiranjanG.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
4. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003.
5. Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces, Arpaci-Dusseau Books, Inc (2015).

222MCT01 –ADVANCED OPERATING SYSTEMS															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	1	2	3	-	-	-	1	-	-	-	-	-	-
CO2	-	1	1	2	3	-	-	-	1	-	-	-	-	-	-
CO3	-	1	1	2	1	-	-	-	1	-	-	-	-	-	-
CO4	-	1	1	2	3	-	-	-	1	-	-	-	-	-	-
CO5	-	1	1	2	3	-	-	-	1	-	-	-	-	-	-
AVG	**-**	**1.4**	**1.00**	**2.00**	**2.60**	**-**	**-**	**-**	**1.00**	**-**	**-**	-	**-**	**-**	-

1–Low2-Medium,3-High,"-"-No Correlation

		L	T	P	C
222MCT02	**MACHINE LEARNING TECHNIQUES**	**3**	**0**	**0**	**3**

OBJECTIVE(S):

- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning.
- To explore the different supervised learning techniques including ensemble methods.
- To learn different aspects of unsupervised learning and reinforcement learning.
- To learn the role of probabilistic methods for machine learning.
- To understand the applications of Machine Learning.

UNIT– I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 9

What is Machine Learning? Need –History – Definitions– Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

UNIT– II SUPERVISED LEARNING 9

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting/Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods–Random Forest - Evaluation of Classification Algorithms

UNIT– III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems – EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning

UNIT– IV PROBABILISTIC METHODS FOR LEARNING ` 9

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models

UNIT– V APPLICATIONS OF MACHINE LEARNING 9

Recommendation Systems – Model for Recommendation Systems, Utility Matrix, Content-Based Recommendations, Discovering Features of Documents, Collaborative Filtering. Advertising on the Web: Issues in Online Advertising, Online and offline algorithms, The matching Problem, The AdWords Problem, The Balance Algorithm. Application of dimensionality reduction-SVD for Latent Semantic Indexing.

TOTAL: 45

COURSEOUTCOMES:

At the end of the course student should be able to :

CO1: Understand and outline problems for each type of machine learning

CO2: Design a Decision tree and Random forest for an application

CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.

CO4: Use a tool to implement typical Clustering algorithms for different types of applications.

CO5: Understand how Machine learning is applied to solve problems in various applications like game playing, recommendation systems, high dimensional analysis

REFERENCES:

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC, 2nd Edition, 2014.
2. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
3. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
4. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
5. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015
6. AnandRajaRaman, Jure Leskovec and J.D. Ullman, "Mining of Massive Data sets", e- book, Publisher, 2014

222MCT02 –MACHINNE LEARNING TECHNIQUES															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	1	2	3	-	-	-	1	-	-	-	-	-	-
CO2	-	1	1	2	3	-	-	-	1	-	-	-	-	-	-
CO3	-	1	1	2	1	-	-	-	1	-	-	-	-	-	-
CO4	-	1	1	2	3	-	-	-	1	-	-	-	-	-	-
CO5	-	1	1	2	3	-	-	-	1	-	-	-	-	-	-
AVG	**-**	**1.4**	**1.00**	**2.00**	**2.60**	**-**	**-**	**-**	**1.00**	**-**	**-**	-	**-**	**-**	-

1–Low2-Medium,3-High,"-"-No Correlation

		L	T	P	C
222MCT03	**NETWORK TECHNOLOGIES AND PROTOCOLS**	**3**	**0**	**0**	**3**

OBJECTIVE(S):

- To appreciate the different aspects routing in optical and mobile networks.
- To understand the issues in networks, the protocols used for the working of wired and wireless networks.
- To understand how routing is done in telephone networks
- To learn about the different internet routing protocols.

UNIT - I INTRODUCTION **9**

ISO OSI Layer Architecture-TCP/IP Layer Architecture – Functions of Network layer-General Classification of routing- Routing in telephone networks-Dynamic Non Hierarchical Routing(DNHR)-Trunk status map routing (TSMR)-Real-time network routing(RTNR)-Distance vector routing-Link state routing-Hierarchical routing.

UNIT – II WIRED LINE AND WIRELESS NETWORKS **9**

LAN IEEE802 Projects-Ethernet-Token Ring–FDDI–MAN–DQDB–SMDS-Wireless LAN-IEEE 802.11–WiFi–SONET- DWDM-DSL-Switching–Circuit Switching-Packet switching Intelligent Networks-LAN bridges.

UNIT - III INTERNET ROUTING PROTOCOLS **9**

Interior routing protocols: Routing Information Protocol (RIP) - Open Shortest Path First (OSPF) – Exterior Routing protocols: Exterior Gateway Protocol(EGP) and Border Gateway Protocol(BGP).Multicast routing :Pros and cons of Multicast and Multiple Unicast Routing - Distance Vector Multicast Routing Protocol (DVMRP) - Multicast Open Shortest Path First(MOSPF) MBONE.

UNIT - IV ADVANCED NETWORKS CONCEPTS **9**

VPN-Remote-Access VPN-site-to-site VPN-Tunneling to PPP-Security in VPN-MPLS-Operation– Routing - Tunneling and Use of FEC - Traffic Engineering and MPLS based VPN - Overlay Networks - P2P Connections - IPv4 vsIPv6.

UNIT – VSOFTWARE DEFINED NETWORKS **9**

SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. Open Flow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. Open Flow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer Network Applications. User Interface.

TOTAL: 45

COURSE OUTCOMES:

CO1: Design routing protocols in Wired and Wireless Environment.
CO2: Acquire the technical competence to meet out the industry expectation on the state – of the art wired / wireless technologies.

CO3: Acquire the ability to design WLAN/ LAN systems meeting out real time requirements.

CO4: Design and configure a network.

CO5: Analyze the evolution of software defined networks.

REFERENCES:

1. William Stallings, "High-Speed Networks and Internets, Performance and Quality of Service", 2nd Edition, Pearson Education Asia, Reprint India, 2002.
2. Martha Steens trup, "Routing in Communication Networks", Prentice Hall International, New York, 1995.
3. Leon Garcia.Widjaja,"Communication Networks", Tata McGraw-Hill, 6th Edition, 2002.
4. Aunurag Kumar, D.Manjunath, Joy Kuri, "Communication Networking", Morgan Kaufmann Publishers, 2011.
5. Jochen Schiller, "Mobile Communications", 2nd Edition, Pearson Education, 2008.
6. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, "Mobile Computing: Technology, Applications and Service Creation", 2nd Edition, Tata McGraw Hill, 2010.
7.William Stallings "–Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" 1st Edition, Pearson Education, 2016.(Unit 4 and 5)
8.Thomas D.Nadeau and Ken Gray, "SDN – Software Defined Networks" ,O"Reilly Publishers, 2013

222MCT03– NETWORK TECHNOLOGIES AND PROTOCOLS															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	-	-	-	-	-	-	-	1	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	2	1	-	-	-	-	-	-	-	-	-
AVG	**3.00**	**3.00**	**-**	**2.00**	**2.00**	**1.00**	**-**	**-**	**-**	**1.00**	**-**	-	**-**	**-**	**-**

1–Low2-Medium,3-High,"- "-No Correlation

222MCP08	MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVE(S):

- Make use of Data sets in implementing the machine learning algorithms
- Identify and Implement the machine learning concepts and algorithms for various applications
- Design learning model for appropriate application
- Explore supervised and unsupervised learning algorithms for real world problems

SUGGESTED LIST OF EXPERIMENTS:

The suggested list Experiments can be implemented using Python

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
3. Classification with Nearest Neighbours. Use scikit-learn's KNN classifer to classify real vs. fake news headlines.
4. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering (You can add Java/Python ML library classes/API in the program).
5. Implementation of applications like document classification, recommendation systems, advertising on the web, using ML tools.
6. Implement a Project with one or more machine learning algorithms applied to same dataset.
    a. Project may be a comparison of several existing algorithms, or may propose a new algorithm in which case it must be compared to at least one existing algorithm.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: Understand and outline problems for each type of machine learning

CO2: Design a Decision tree and Random forest for an application

CO3: Implement Nearest Neighbour algorithms for an application and analyze the results.

CO4: Use a tool to implement typical Clustering algorithms for different types of applications.

CO5: Design and implement a project based application and identify suitable Machine Learning Algorithm.

SEMESTER - III

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PC	322MCT01	Principles of Modern Cryptography	3	0	0	3	40	60	100
2	PC	322MCT02	Internet of Things	3	0	0	3	40	60	100
3	PE	X22MCExx	Professional Elective – **III**	3	0	0	3	40	60	100
4	PE	X22MCExx	Professional Elective –I**V**	3	0	0	3	40	60	100
			PRACTICALS							
5	EEC	322MCP05	Project Work Phase-I	0	0	12	6	40	60	100
			TOTAL MANDATORY CREDITS				**18**			

		L	T	P	C
322MCT01	**PRINCIPLES OF MODERN CRYPTOGRAPHY**	**3**	**0**	**0**	**3**

OBJECTIVE(S):

- To gain knowledge about the mathematics of the cryptographic algorithms.
- To get an insight into the working of different existing cryptographic algorithms.
- Describe the principles of public key cryptosystems, hash functions and message authentication.
- To learn how to use cryptographic algorithms in security.
- To correctly interpret the answers generated by inferential and computational tools

UNIT– I INTRODUCTION AND BLOCKCIPHERS. 9

Introduction, Cryptography and Modern cryptography, The One-Time Pad, Block Ciphers – DES – Key Recovery Attacks on Block Ciphers – Iterated-DES and DESX – AES, Limitations of Perfect Secrecy, Shannon's Theorem

UNIT– II PSEUDO RANDOM FUNCTIONS AND PRIVATE KEY CRYPTOGRAPHY 9

Computational Security, Semantic Security, Pseudorandom Generators and Stream Ciphers, Proofs by Reduction, CPA-Secure Encryption from Pseudorandom Functions, Modes of Operations, Chosen-Cipher text Attacks

UNIT– III MESSAGE AUTHENTICATION AND HASH FUNCTIONS 9

Message Integrity, Message Authentication Codes, Fixed length MAC, CBC MAC, Authenticated Encryption-Secure Communication Sessions, CCA Secure Encryption, Collision Resistance, The Birthday Attack, Fingerprinting and Deduplication, Merkle Trees, Password Hashing

UNIT– IV NUMBER THEORY AND PUBLIC KEY CRYPTOGRAPHY 9

Isomorphisms and the Chinese Remainder Theorem, Primality Testing, The Discrete-Logarithm/Diffie–Hellman Assumptions, Hybrid Encryption and the KEM/DEM Paradigm, El Gamal's Encryption, Digital Signature Algorithm

UNIT– V SECURITY AND ADVANCES IN PUBLIC KEY CRYPTOGRAPHY 9

Electronic Mail Security, IP Security, Digital Cash, Blind Signature, Homomorphic Encryption, Secret Sharing and Threshold Encryption, The Goldwasser–Micali Encryption Scheme, The Rabin Encryption Scheme

TOTAL: 45

COURSE OUTCOMES:

At the end of the course student should be able to

CO1: Demonstrate the various classical encryption techniques and the adversary capabilities.

CO2: Blending the existing cryptographic algorithms with the existing communication protocols

CO3: Apply number theory in public key encryption techniques.

CO4: Apply computational secrecy and semantic security to find out the probability of how strong are the security schemes.

CO5: Analyze the application of cryptography for secure mail services and other secret transactions.

1. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", Chapman and Hall/CRC Press Second Edition,2015.
2. Hans Delfts and Helmut Knebl, "Introduction to Cryptography – Principles and Applications", Springer, Third Edition by,2015.
3. W. Stallings, Cryptography and Network Security Principles and practice, 5/e, Pearson Education Asia, 2012.
4. Behrouz A. Forouzan and DebdeepMukhopadhyay, Cryptography and Network Security, second edition, Tata McGraw Hill, 2011

CO's-PO's & PSO's MAPPING:

322MCT01–PRINCIPLES OF MODERN CRYPTOGRAPHY															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	3	-	-	-	-	-	-	3	3	3	2
CO2	3	3	2	3	3	-	-	-	-	-	-	3	3	3	2
CO3	3	2	2	2	3	-	-	-	-	-	-	3	3	3	2
CO4	3	2	2	3	3	-	-	-	-	-	-	3	3	3	2
CO5	2	2	2	3	3	-	-	-	-	-	-	3	3	3	2
AVG	2.8	2.4	2	2.8	3	-	-	-	-	-	-	3	3	3	2

1–Low2Medium,3-High,"-"-No Correlation

		L	T	P	C
322MCT02	**INTERNET OF THINGS**	**3**	**0**	**0**	**3**

OBJECTIVE(S):

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To learn Reference architectures for different levels of IoT applications.
- To learn IoT data analytics and Tools for IoT

UNIT - I INTRODUCTION **9**

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG

UNIT – II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS **9**

IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics

UNIT - III IoT PROTOCOLS AND TECHNOLOGY **9**

SCADA and RFID Protocols - BACnet Protocol -Zigbee Architecture - 6LowPAN - CoAP –Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

UNIT - IV FIELD AREA NETWORKS **9**

Roles and responsibilities of nodes, border routers, field area gateways; Mesh networks - mesh over and mesh under; IP based communication; Communication vs power tradeoff in the network; Low power WAN technologies; low power PAN technologies; Emerging standards; IOT network management - bootstrapping and management; Messaging in IOT systems - XML, JSON, EXi, binary

UNIT – VIOT APPLICATION DEVELOPMENT **9**

IoT Platforms Design Methodology; Multi-tier Application Deployment ,IOT platform case studies; Databases for IOT - managing high velocity data; Introduction to Cloud setup; Introduction to Hadoop and managing Big Data; Data Analytics and real time processing; Statistical modelling of data; Introduction to web app development using MVC methodology. Introduction to mobile application development

TOTAL: 45

COURSE OUTCOMES:

CO1: Understand the various concept of the IoT and their technologies
CO2: Develop the IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Will know in a manner how the general Internet as well as Internet of Things work
CO5: Will be able to identify a suitable IOT data analytics and a tool for IOT.

REFERENCES:

1. ArshdeepBahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
4. OvidiuVermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
5. M. Wang, G. Zhang, C. Zhang, J. Zhang, C. Li, An IoT-based Appliance ControlSystem forSmartHomes, ICICIP 2013.
6. H. Zhang, J. Guo, X. Xie, R. Bie, Y,Sun, Environmental Effect Removal Based Structural Health
7. Monitoring in the Internet of Things, International Conference on Innovative Mobile and Internet, Services in Ubiquitous Computing (IMIS), 2013

CO's-PO's & PSO's MAPPING:

322MCT02–INTERNET OF THINGS															
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	3	-	-	-	-	-	-	3	3	3	2
CO2	3	3	2	3	3	-	-	-	-	-	-	3	3	3	2
CO3	3	2	2	2	3	-	-	-	-	-	-	3	3	3	2
CO4	3	2	2	3	3	-	-	-	-	-	-	3	3	3	2
CO5	2	2	2	3	3	-	-	-	-	-	-	3	3	3	2
AVG	2.8	2.4	2	2.8	3	-	-	-	-	-	-	3	3	3	2

1–Low2-Medium,3-High,"- "-No Correlation

AUDIT COURSES (AC)
Registration for any of these courses is optional to students

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C
1	AC	X22GAT01	English For Research Paper Writing	2	0	0	0
2	AC	X22GAT02	Disaster Management	2	0	0	0
3	AC	X22GAT03	Constitution Of India	2	0	0	0
4	AC	X22GAT04	நற்றமிழ்இலக்கியம்	2	0	0	0

X22GAT01 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

COURSE OBJECTIVES:

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions95

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's
5. book 1998

X22GAT02 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

COURSE OBJECTIVES:

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics96

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk:
Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company,2007.
3. Sahni, Pradeep Et.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

PROFESSIONAL ELECTIVES - DOMAIN- 1 (NETWORKS)

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE11	Ad-Hoc Network	3	0	0	3	40	60	100
2	PE	X22MCE12	Wireless Sensor Nework	3	0	0	3	40	60	100
3	PE	X22MCE13	Distributed Systems	3	0	0	3	40	60	100
4	PE	X22MCE14	Cloud Computing	3	0	0	3	40	60	100
5	PE	X22MCE15	Cyber Physical Systems	3	0	0	3	40	60	100
6	PE	X22MCE16	High Performance Computing for Big Data	3	0	0	3	40	60	100

X22MCE11	AD-HOC NETWORKS	L T P C 3 0 0 3

COURSE OBJECTIVES:

This course will enable students to

- Understand fundamental principles of Ad-hoc Networks
- Realizing a Protocols for Ad-hoc network
- Outline current and emerging trends in Ad-hoc Wireless Networks.
- Analyze energy management in ad-hoc wireless networks.

UNIT I INTRODUCTION & MAC PROTOCOLS **9**

Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas.

UNIT II ROUTING PROTOCOLS **9**

Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.

UNIT III MULTICAST ROUTING PROTOCOLS **9**

Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols.

UNIT IV TRANSPORT LAYER & SECURITY **9**

Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad-hoc Wireless Networks.

UNIT V QoS & ENERGY MANAGEMENT **9**

Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes.

Total: 45

COURSE OUTCOMES:

The students shall able to:

CO1: Design their own wireless network
CO2: Evaluate the existing network and improve its quality of service
CO3: Choose appropriate protocol for various applications
CO4: Examine security measures present at different level
CO5: Analyze energy consumption and management

Reference Books:

1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011
2. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
3. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
4. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

X22MCE11–AD-HOC NETWORKS												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	-
AVG	**3.00**	-	**3.00**	-	-	-	-	-	-	**1.00**	-	-

X22MCE12 **WIRELESS SENSOR NETWORKS** **L T P C**
3 0 0 3

Course Objectives:

- To study the concept of different wireless networks.
- To introduce basic tools used for simulation of wireless network.
- To introduce basic concept of security in WSM.
- To study the hardware of various wireless networks with brief over new of protocols for sensor networks.

UNIT I INTRODUCTION **9**

Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

UNIT II SENSOR NETWORK HARDWARES & SOFTWARES **9**

Hardware, Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS. Programming tools, C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

UNIT III SENSOR NETWORK PROTOCOLS **9**

Overview of sensor network protocols (details of atleast 2 important protocol per layer), Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.

UNIT IV ROUTING PROTOCOLS FOR WSN **9**

Data dissemination and processing, differences compared with other database management systems, data storage; query processing, Data gathering. Routing Challenges and Design Issues in WSN,Routing strategies in WSN, Routing Metrics, Flooding and Gossiping, Data-centricrouting,ProactiveRouting,On-DemandRouting,HierarchicalRouting,LocationRouting,QoSbasedRoutingProtocols

UNIT V SPECIALIZED FEATURES **9**

Specialized features, Energy preservation and efficiency, security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms, coverage issues, sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

TOTAL: 45 HOURS

Course Outcomes:

On successful completion of this course, the students should be able to:

CO1: Design wireless sensor network system for different applications under consideration.

CO2: Understand the hardware details of different types of sensors and select right type of sensor for various applications.

CO3: Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.

CO4: Apply knowledge on routing protocols for sensor networks and solve thedesignissues

CO5: Handle special issues related to sensors like energy conservation.

REFERENCES:

1. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.

2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.

3. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.

4. YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technologies

CO-PO MAPPING:

X22MCE12 - WIRELESS SENSOR NETWORKS												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	-
AVG	**1.75**	**-**	**2.00**	**-**	**-**	**-**	**1.00**	**-**	**-**	**2.00**	-	-

X22MCE13 **DISTRIBUTED SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The learning objectives for Distributed Systems are:

1. Apply knowledge of distributed systems techniques and methodologies.
2. Explain the design and development of distributed systems and distributed systems applications.
3. Use the application of fundamental Computer Science methods and algorithms in the development of distributed systems and distributed systems applications.
4. Discuss the design and testing of a large software system, and to be able to communicate that design to others.

UNIT I INTRODUCTION TO DISTRIBUTED SYSTEMS 9

Characteristics of distributed systems - Challenges of distributed systems - such as concurrency control - fault tolerance - scalability - Types of distributed systems - such as client-server - peer-to-peer, and distributed databases - Examples of distributed systems - such as the Internet and cloud computing platforms.

UNIT II COMMUNICATION AND COORDINATION IN DISTRIBUTED SYSTEMS 9

Communication protocols and architectures for distributed systems - such as message passing - remote procedure calls and RESTful APIs - Consistency models for distributed systems - such as eventual consistency and strong consistency - Techniques for coordination in distributed systems - such as distributed locking and two-phase commit

UNIT III DISTRIBUTED FILE SYSTEMS 9

Concepts and design of distributed file systems - such as NFS and HDFS - File system interfaces and APIs, such as POSIX and S3 - Techniques for managing data in distributed file systems - such as data eplication and caching

UNIT IV DISTRIBUTEDCOMPUTING 9

Models for distributed computing - such as MapReduce and Spark - Programming models for distributed computing - such as shared memory and message passing - Distributed algorithms - such as distributed sorting and graph processing

Unit V DISTRIBUTED SYSTEMS MANAGEMENT AND SECURITY 9

Management of distributed systems - such as monitoring – logging and debugging - Techniques for ensuring security in distributed systems - such as authentication and access control - Emerging trends in distributed systems, such as edge computing and blockchain

Course Outcomes:

On successful completion of this course, the students should be able to:
CO1: Explain various architectures used to design distributed systems, such as client-server and peer-to-peer.
CO2: Build distributed systems using various inter process communication techniques, such as remote method invocation, remote events, and tuple spaces.
CO3: Build distributed systems using various techniques for tolerating partial failures, such as leasing and replication.
CO4: Explain various distributed algorithms, such as logical clocks and leader election.
CO5: Analyze and explain current distributed systems research literature.

REFERENCES:

1. Andrew S. Tannenbaum and Maarten van Steen “Distributed Systems: Principles and Paradigms”, Second Edition, Prentice Hall, October 2006.
2. Ajay D. Kshemkalyani and MukeshSinghal, “Distributed Computing: Principles, Algorithms, and Systems”, Cambridge University Press, 2011.
3. Vijay K Garg, “Elements of Distributed Computing”, Wiley-IEEE Press, May 2002
4. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, “Distributed Systems: Concepts and Design”, Fifth Edition, Addison Wesley, 2012.
5. MukeshSinghal and Niranjan Shivaratri, “Advanced Concepts in Operating Systems, McGraw-Hill.
6. Mahmoud Parsian, “Data Algorithms: Recipes for Scaling Up with Hadoop and Spark”, O’Reilly Media.

CO-PO MAPPING:

X22MCE13 - DISTRIBUTED SYSTEMS												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	-
AVG	**1.25**	-	-	-	-	**1.00**	-	-	-	**1.00**	-	-

X22MCE14 CLOUDCOMPUTING L T P C
3 0 0 3

CourseObjectives

- Tounderstand theconceptsofvirtualizationandvirtualmachines
- Togainexpertiseinserver,networkand storagevirtualization.
- TogainknowledgeontheconceptofvirtualizationthatisfundamentaltoCloudcomputing
- Tounderstandthevariousissuesincloudcomputing
- Tobeabletosetupaprivatecloud and understandthesecurityissuesinthegridandthecloudenvironment

UNITI VIRTUALIZATION 9

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – ManagementVirtualization – Hardware Maximization – Architectures – Virtualization Management – StorageVirtualization– NetworkVirtualization

UNITII VIRTUALIZATIONINFRASTRUCTURE 9

ComprehensiveAnalysis– ResourcePool–TestingEnvironment– ServerVirtualization–Virtual Work loads– ProvisionVirtualMachines– DesktopVirtualization–Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization ofCPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization fordata centerautomation.

UNITIII CLOUDPLATFORMARCHITECTURE 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing:Everythingasaservice:Infrastructure,platform,software - AGenericCloudArchitectureDesign – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud ResourceManagement

UNITIV PROGRAMMINGMODEL 9

Introduction toHadoop Framework- Mapreduce,Inputsplitting,map and reducefunctions,specifying input and output parameters, configuring and running a job – Developing Map ReduceApplications- DesignofHadoopfilesystem– SettingupHadoopCluster- CloudSoftwareEnvironments- Eucalyptus,OpenNebula,OpenStack,Nimbus

UNITV CLOUDSECURITY 9

CloudInfrastructure security:network, hostandapplicationlevel – aspects of data security,provider data and its security, Identity and access management architecture, IAM practices in thecloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud SecurityandTrustManagement

Total:45periods

CourseOutcomes

Attheendofthecoursethestudentsare ableto

CO1:Employtheconceptsofstoragevirtualization,networkvirtualizationanditsmanagement

CO2: Applytheconceptofvirtualizationinthecloudcomputing

CO3: Identifythearchitecture,infrastructureanddeliverymodelsofcloudcomputing

CO4: DevelopservicesusingCloudcomputing

CO5: Applythesecuritymodelsinthecloudenvironment

REFERENCEBOOKS:

1. DanielleRuest,Nelson Ruest,—Virtualization:A Beginners Guide‖McGraw-Hill OsborneMedia,2009.
2. JimSmith, RaviNair,"VirtualMachines:VersatilePlatformsforSystemsandProcesses",Elsevier/MorganKaufmann,2005
3. JohnW.RittinghouseandJamesF.Ransome,"CloudComputing:Implementation,Management,andSecurity",CRC Press,2010.
4. KaiHwang,GeoffreyCFox,JackGDongarra,"DistributedandCloudComputing,From ParallelProcessingtotheInternet ofThings",MorganKaufmannPublishers,2012.
5. TimMather,SubraKumaraswamy,andShahedLatif, "CloudSecurityandPrivacy", O'Reilly Media,Inc.,2009.
6. To by Velte, Anthony Velte, Robert Elsenpeter,"Cloud Computing,A Practical Approach",McGraw HillOsborneMedia,2009.
7. TomWhite,"Hadoop:TheDefinitiveGuide",YahooPress,2012

CO-PO MAPPING:

X22MCE14 - CLOUDCOMPUTING												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	1	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	-
AVG	**3.00**	**-**	**3.00**	**2.00**	**-**	**-**	**-**	**-**	**-**	**1.00**	**-**	-

X22MCE15 **CYBER PHYSICAL SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn about the principles of cyber-physical systems
- To familiarize with the basic requirements of CPS
- To Analyse Intelligent CPS & apply modern tools to develop CPS applications
- To make the students explore the applications and platforms.
- To provide introduction to practical aspects of cyber physical systems.

UNIT I CYBER PHYSICAL SYSTEMS **9**

Cyber-Physical Systems (CPS) in the real world - Basic principles of design and validation of CPS - models of physical process, finite state machines, computation, converters between physical and cyber variables, and digital networks - Industry 4.0 – Auto SAR - IIOT implications - Building Automation - Medical CPS

UNIT II CPS – REQUIREMENTS & PLATFORM COMPONENTS **9**

Safety Specifications: Specifications- Requirements: Temporal Logic, Model Checking, Proving Liveness CPS HW platforms - Processors, Sensors, Actuators - mCPS Network – Wireless Hart, CAN, Automotive Ethernet - CPS Sw stack - RTOS - Scheduling Real Time control tasks

UNIT III PRINCIPLES OF AUTOMATED CONTROL DESIGN **9**

Dynamical Systems and Stability - Controller Design Techniques - Stability Analysis: CLFs, MLFs, stability under slow switching - Performance under Packet drop and Noise - Tutorial: Matlab toolboxes - Simulink, State flow Features to software components - Mapping software components to ECUs - CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion

UNIT IV INTELLIGENT CPS **9**

Safe Reinforcement Learning - Robot motion control - Autonomous Vehicle control – Gaussian Process Learning - Smart Grid Demand Response - Building Automation

UNIT V SECURE DEPLOYMENT OF CPS & APPLICATION OF CPS **9**

Secure Task mapping and Partitioning - State estimation for attack detection – Automotive Case study : Vehicle ABS hacking - Power Distribution Case study : Attacks on Smart Grids – Virtual Instrumentation – Applications of CPS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

CO1: Explain the core principles behind CPS

CO2: Discuss the requirements of CPS.

CO3: Use Modern tools for CPS applications

CO4: Develop CPS real time Applications

CO5: Use the various platforms to implement the CPS & Solve Security issues in CPS

REFERENCES:

1. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.

2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.

3. T. D. Lewis "Network Science: Theory and Applications", Wiley, 2009.

4. P. Tabuada, "Verification and control of hybrid systems: a symbolic approach", Springer Verlag 2009.

5. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer, 2007.

6. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996.

X22MCE15 - CYBER PHYSICAL SYSTEMS												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	-	1	-	-	-	-	-	-	-
CO2	2	2	2	-	1	-	-	-	-	-	-	-
CO3	-	-	3	1	-	1	-	-	-	-	-	-
CO4	-	-	3	1	-	1	-	-	-	-	-	-
CO5	2	-	2	3	3	3	-	-	-	-	-	-
AVG	**2.33**	**2.5**	**2.6**	**1.33**	**1.33**	**1.33**	-	-	-	-	-	-

X22MCE16 HIGH PERFORMANCE COMPUTING FOR BIG DATA L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the fundamental concepts of High Performance Computing.
- To learn the network & software infrastructure for high performance computing.
- To understand real time analytics using high performance computing.
- To learn the different ways of security perspectives and technologies used in HPC.
- To understand the emerging big data applications.

UNIT I INTRODUCTION 9

The Emerging IT Trends - IOT/IOE - Apache Hadoop for big data analytics-Big data into big insights and actions – Emergence of BDA discipline – strategic implications of big data – BDA Challenges – HPC paradigms – Cluster computing – Grid Computing – Cloud computing – Heterogeneous computing – Mainframes for HPC - Supercomputing for BDA – Appliances for BDA.

UNIT II NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA 9

Design of Network Infrastructure for high performance BDA – Network Virtualization – Software Defined Networking – Network Functions Virtualization – WAN optimization for transfer of big data – started with SANs- storage infrastructure requirements for storing big data – FC SAN – IP SAN – NAS – GFS – Panasas – Luster file system – Introduction to cloud storage.

UNIT III REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING 9

Technologies that support Real time analytics – MOA: Massive online analysis – GPFS: General parallel file system – Client case studies – Key distinctions – Machine data analytics – operational analytics – HPC Architecture models – In Database analytics – In memory analytics

UNIT IV SECURITY AND TECHNOLOGIES 9

Security, Privacy and Trust for user – generated content: The challenges and solutions – Role of real time big data processing in the IoT – End to End Security Framework for big sensing data streams – Clustering in big data.

UNIT V EMERGING BIG DATA APPLICATIONS 9

Deep learning Accelerators – Accelerators for clustering applications in machine learning - Accelerators for classification algorithms in machine learning – Accelerators for Big data Genome Sequencing

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

CO1: Understand the basics concepts of High Performance computing systems.
CO2: Apply the concepts of network and software infrastructure for high performance computing
CO3: Use real time analytics using high performance computing.
CO4: Apply the security models and big data applications in high performance computing
CO5: Understand the emerging big data applications.

REFERENCES:

1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, "High Performance Big-Data Analytics: Computing Systems and Approaches", Springer, 1st Edition, 2015.
2. "Big Data Management and Processing", Kuan-Ching Li, Hai Jiang, Albert Y. Zomaya, CRC Press, 1st Ed, 2017.
3. "High Performance Computing for Big Data: Methodologies and Applications", Chao wang, CRC Press, 1st Edition, 2018.
4. "High-Performance Data Mining And Big Data Analytics", KhosrowHassibi, Create Space Independent Publishing Platform, 1st Edition, 2014.
5. "High performance computing: Modern systems and practices", Thomas Sterling, Mathew Anderson, Morgan Kaufmann publishers, 1st Edition, 2017.

WEB REFERENCES:

1. https://www.hpcwire.com/

ONLINE RESOURCES:

1. http://hpc.fs.uni-lj.si/sites/default/files/HPC_for_dummies.pdf
2. https://www.nics.tennessee.edu/computing-resources/what-is-hpc

X22MCE16 - HIGH PERFORMANCE COMPUTING FOR BIG DATA												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	1	-	-	-	-	-	-	-	-
CO2	-	-	2	3	2	3	-	-	-	-	-	-
CO3	1	-	1	-	1	3	-	-	-	-	-	-
CO4	3	1	-	-	3	-	-	-	-	-	-	-
CO5	1	-	-	2	3	-	-	-	-	-	-	-
AVG	**1.75**	**1.5**	**2**	**2**	**2.25**	**3**	-	-	-	-	-	-

PROFESSIONAL ELECTIVES - DOMAIN -II (SECURITY)

S.No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE21	Cyber Security	3	0	0	3	40	60	100
2	PE	X22MCE22	Crypto Currency &Blockchain Technologies	3	0	0	3	40	60	100
3	PE	X22MCE23	Ethical Hacking	3	0	0	3	40	60	100
4	PE	X22MCE24	Security and Privacy in Cloud	3	0	0	3	40	60	100
5	PE	X22MCE25	Computer Forensics	3	0	0	3	40	60	100
6	PE	X22MCE26	BioInformatics	3	0	0	3	40	60	100

		L	T	P	C
X22MCE21	**CYBER SECURITY**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn cybercrime and cyber law.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber-attack**.**

UNIT I INTRODUCTION **9**

Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes– A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment

UNIT II ATTACKS AND COUNTERMEASURES **9**

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures**.**

UNIT III RECONNAISSANCE **9**

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques

UNIT IV INTRUSION DETECTION **9**

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT V INTRUSION PREVENTION **9**

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations –Intrusion Prevention Systems – Example Unified Threat Management Products.

TOTAL: 45

COURSE OUTCOMES:

Attheendofthecoursestudent shouldbeableto

CO1: Explain the basics of cyber security, cybercrime and cyber law

CO2: Classify various types of attacks and learn the tools to launch the attacks

CO3 Apply various tools to perform information gathering

CO4: Apply intrusion techniques to detect intrusion

CO5: Apply intrusion prevention techniques to prevent intrusion

REFERENCES

1. David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013

2. Patrick Engebretson, “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy”, Elsevier, 2011

3. Kimberly Graves, “CEH Official Certified Ethical hacker Review Guide”, Wiley Publishers, 2007

4. William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, Third Edition, Pearson Education, 2015

X22MCE21 – CYBER SECURITY												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	2	-	1	-	-	1	1	2	2
CO2	1	1	1	2	2	1	-	-	1	1	2	2
CO3	1	1	1	2	-	1	-	-	1	1	2	2
CO4	1	1	1	2	2	1	-	-	1	1	2	2
CO5	1	1	1	2	1	1	-	-	1	1	2	2
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**1.00**	**-**	**-**	**1.00**	**1.00**	**2.00**	**2.00**

X22MCE22 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES L T P C

3 0 0 3

OBJECTIVE(S):

- To understand the basics of Blockchain
- To understand the basics of Crypto currency
- To study the basics of Hyperledger and Web3
- To know about alternative Blockchains and Blockchain projects in different domains

UNIT–I OVERVIEW OF CRYPTOCURRENCY 9

Bitcoin: Bitcoin Working - Bitcoin Transactions - Bitcoin Mining - Value of Bitcoin - Community, Politics and Regulations – Advantages – Disadvantages. Ethereum: Overview – Decentralized Application. Components of Ethereum: Smart contracts – Ether - Ethereum Clients – Ethereum Virtual Machine – Etherscripter.

UNIT–II BLOCKCHAIN 9

Need for Blockchain - The Structure of Blockchain - Data Structure of Blockchain - Data Distribution in Blockchain - Block Validation. Block Validators**:** Consensus - Proof of Work – Proof of Stake - Proof of Activity - Proof of Elapsed Time - Proof of Burn.

UNIT– III DEVELOPMENT FRAMEWORKS 9

Digital Tokens: Overview - Initial Coin Offering – OmiseGO – EOS – Tether. Meta Mask: Wallet Seed – Meta Mask Transactions. Mist: Overview - Mist wallet. Truffle: Features of Truffle – Development Truffle boxes - Community truffle box.

UNIT–IV WEB3 AND HYPERLEDGER 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric –Distributed Ledger – Corda.

UNIT–V BLOCKCHAIN PLATFORMS AND EMERGING TRENDS 9

Multichain - HydraChain**.** Future Blockchain**:** IOTA **–** Corda - Chain Core.Blockchain Framework**:** CoCo Framework – Tierion – BigchainDB-Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL:45

COURSEOUTCOMES:

Attheendofthecoursestudent shouldbeableto

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: Understand and use Hyperledger and its development framework.

CO5: Track alternative Blockchains and emerging trends in Blockchain.

REFERENCES:

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 Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 1st Edition, 2015.
4. Antony Lewis, The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them, Mango Publishing group, 2018.
5. Tiana Laurence, Introduction to Blockchain Technology, 1st Edition, Van Haren Publishing, 2019.
6. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.

X22MCE22 - CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	2	1	-	-	-	-	-	-	2
CO2	1	1	1	2	1	-	-	-	-	-	-	2
CO3	1	1	1	2	1	-	-	-	-	-	-	2
CO4	1	1	1	2	1	-	-	-	-	-	-	2
CO5	1	1	1	2	1	-	-	-	-	1	1	2
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**1**	**1**	**2.00**

X22MCE23 **ETHICAL HACKING** **L T P C**

3 0 0 3

OBJECTIVE(S):

- To understand and analyze Information security threats & counters measures.
- To perform security auditing & testing
- To understand issues relating to ethical hacking
- To study &employ network defense measures
- To understand penetration and security testing issues

UNIT–I ETHICAL HACKING OVERVIEW **9**

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Foot printing – Information Gathering Methodology – Foot printing Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines.

UNIT–II SCANNING AND ENUMERATION **9**

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools.

UNIT– III SYSTEM HACKING **9**

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Counter measures – Escalating Privileges –Executing Applications – Key loggers and Spyware.

UNIT–IV PROGRAMMING FOR SECURITY PROFESSIONALS **9**

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.

UNIT–V PENETRATION TESTING **9**

Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools

TOTAL:45

COURSEOUTCOMES:

At the end of the course student should be able to

CO1: Understand vulnerabilities in Ethical hacking

CO2: Identify vulnerabilities/threats/attacks

CO3: Perform penetration & security testing

CO4: Become a professional ethical hacker

CO5: Analyze the application of Ethical Hacking & use of standard hacking tools in an ethical manner.

REFERENCES:

1. EC-Council, —Ethical Hacking and Countermeasures: Attack Phases‖, Delmar Cengage Learning, 2015.
2. Behrouz A. Forouzan and DebdeepMukhopadhyay, Cryptography and Network Security, second edition, Tata McGraw Hill, 2011
3. Michael T. Simpson,"Hands-on Ethical Hacking & Network Defense", Course Technology, 2010
4. Patrick Engebretson, —The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy‖, Syngress Media, Second Revised Edition, 2013.
5. RajatKhare, "Network Seuciry and Ethical Hacking", Luniver Press, 2006
6. Ramachandran V,BackTrack 5 Wireless Penetration Testing Beginner's Guide 3rd ed.. Packt Publishing, 2011

X22MCE23 – ETHICAL HACKING												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	-	-	-	1	-	-	-	-	-
AVG	**1.75**	**-**	**2.00**	**-**	**-**	**-**	**1.00**	**-**	**-**	**2.00**	-	-

X22MCE24	SECURITY AND PRIVACY IN CLOUD	L T P C 3 0 0 3

COURSE OBJECTIVES:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS **9**

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II SECURITY DESIGN AND ARCHITECTURE FOR CLOUD **9**

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies – Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III ACCESS CONTROL AND IDENTITY MANAGEMENT **9**

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV CLOUD SECURITY DESIGN PATTERNS **9**

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V MONITORING, AUDITING AND MANAGEMENT **9**

Proactive activity monitoring - Incident Response, monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

TOTAL:45

COURSE OUTCOMES:

Attheendofthecoursestudent shouldbeableto

CO1: Understand the cloud concepts and fundamentals.

CO2: Explain the security challenges in the cloud.

CO3: Define cloud policy and Identity and Access Management.

CO4: Understand various risks and audit and monitoring mechanisms in the cloud.

CO5: Define the various architectural and design considerations for security in the cloud.

REFERENCES:

1. Raj Kumar Buyya , James Broberg, andrzejGoscinski, “Cloud Computing:”, Wiley 2013
2. Dave shackleford, “Virtualization Security”, SYBEX a wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, “Cloud Security and Privacy”, OREILLY 2011
4. Mark C. Chu-Carroll —Code in the Cloud‖,CRC Press, 2011
5. Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

X22MCE24 – SECURITY AND PRIVACY IN CLOUD												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	2	1	-	-	-	1	1	2	2
CO2	1	1	1	2	1	-	-	-	1	1	2	2
CO3	1	1	1	2	1	-	-	-	1	1	2	2
CO4	1	1	1	2	1	-	-	-	1	1	2	2
CO5	1	1	1	2	1	-	-	-	1	1	2	2
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**-**	**-**	**-**	**1.00**	**1.00**	**2.00**	**2.00**

X22MCE25 **COMPUTER FORENSICS** **L T P C**
3 0 0 3

OBJECTIVE(S):

- Have an understanding of the fundamental concepts of forensic science.
- Have a basic understanding of the application of forensic science principles to digital evidence examinations
- Be able to articulate the steps of the forensic process as applied to digital evidence
- Be able to draft a Standard Operating Procedure.
- Conduct rudimentary digital forensic examinations

UNIT–I INTRODUCTION **9**

Introduction - Digital Forensics - Digital Evidence - Increasing Awareness of Digital Evidence - Digital Forensics: Past, Present, and Future – Principles - Challenging Aspects of Digital Evidence – Cyber trail - Language of Computer Crime Investigation - Role of Computers in Crime.

UNIT–II EVIDENCE AND INVESTIGATIONS **9**

Evidence in the Courtroom - Duty of Experts – Admissibility - Levels of Certainty in Digital Forensics - Direct versus circumstantial evidence - Scientific Evidence - Presenting Digital Evidence - Conducting Digital Investigations - Digital Investigation Process Models - Scaffolding for Digital Investigations - Applying the Scientific Method in Digital Investigations - Investigative Scenario: Security Breach

UNIT– III OPEN SOURCE EXAMINATION PLATFORM **9**

Open Source Examination Platform - Using Linux and Windows as the Host, Disk and File System Analysis, Media Analysis Concepts, Sleuth Kit, Partitioning and Disk Layouts, Special Containers, Hashing

UNIT–IV DISK AND FILE SYSTEM ANALYSIS. **9**

Imaging, Internet Artifacts, Browser & Mail Artifacts, File Analysis, Image, Audio, Video, Archives, Documents, Graphical Investigation Environments, PyFLAG, Fiwalk, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition.

UNIT–V CURRENT COMPUTER FORENSICS TOOLS **9**

Current computer forensics tools- software, hardware tools, validating and testing forensic softwareaddressing data-hiding techniques, performing remote acquisitions, E-Mail investigations-investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

TOTAL:45

COURSEOUTCOMES:

Attheendofthecoursestudent shouldbeableto

CO1: Have an idea regarding the fundamental concepts of forensic science.

CO2: Can apply the concepts and will be able to collect digital evidence.

CO3: Able to Implement the forensic concepts in open platform.

CO4: Able to apply the Standard Operating Procedure.

CO5: Present the forensic evidence in terms of Legal procedure.

REFERENCES:

a. Cory Altheide and Harlan Carvey, —Digital Forensics with Open Source Tools‖ Elsevier publication, 3rd Edition, April 2011.
b. Eoghan Casey , —Digital Evidence and Computer Crime", Forensic Science, Computers, and the Internet, Elsevier, 3rd Edition, 2011
c. Kevin Mandia, Chris Prosise, Matt Pepe, —Incident Response and Computer Forensics —, TataMcGraw -Hill, New Delhi, 2006.
d. Nelson Phillips and EnfingerSteuart, —Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.
e. Robert M Slade,‖ Software Forensics‖, Tata McGraw - Hill, New Delhi, 2005.

X22MCE25 – COMPUTER FORENSICS												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1		2	1	-	-	-	-	-	-	2
CO2	1	1		2	1	-	-	-	-	-	-	2
CO3	1	1		2	1	-	-	-	-	-	-	2
CO4	1	1		2	1	-	-	-	-	1	-	2
CO5	1	1		2	1	-	-	-	-	1	-	2
AVG	**1.00**	**1.00**		**2.00**	**1.00**	**-**	**-**	**-**	**-**	**1**	**-**	**2.00**

X22MCE26 **BIO INFORMATICS** **L T P C**
3 0 0 3

OBJECTIVE(S):

- Exposed to the need for Bioinformatics technologies
- Be familiar with the modeling techniques
- Learn microarray analysis
- Exposed to Pattern Matching and Visualization
- To know about Microarray Analysis

UNIT–I INTRODUCTION **9**

Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System.

UNIT–II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS **9**

Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

UNIT– III MODELING FOR BIOINFORMATICS **9**

Hidden Markov modeling for biological data analysis – Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling –Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks – Molecular modeling – Computer programs for molecular modeling.

UNIT–IV PATTERN MATCHING AND VISUALIZATION **9**

Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of biological sequences – DNA, Protein, Amino acid sequences.

UNIT–V MICROARRAY ANALYSIS **9**

Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model – Benchmark – Tradeoffs.

TOTAL:45

COURSEOUTCOMES:

Attheendofthecoursestudent shouldbeableto

CO1: Understand the different Data formats

CO2: Develop machine learning algorithms

CO3: Develop models for biological data

CO4: Apply pattern matching techniques to bioinformatics data – protein data genomic data

CO5: Apply micro array technology for genomic expression study.

REFERENCES:

1) Yi-Ping Phoebe Chen (Ed), "BioInformatics Technologies", First Indian Reprint, Springer Verlag, 2007.
2) Bryan Bergeron, "Bio Informatics Computing", Second Edition, Pearson Education, 2015.
3) Arthur M Lesk, "Introduction to Bioinformatics", Second Edition, Oxford University Press, 2019

X22MCE26 – BIO INFORMATICS												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	2	1	-	-	-	-	-	-	2
CO2	1	1	1	2	1	-	-	-	-	-	-	2
CO3	1	1	1	2	1	-	-	-	-	-	-	2
CO4	1	1	1	2	1	-	-	-	-	-	-	2
CO5	1	1	1	2	1	1	-	-	-	1	1	2
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**1**	**-**	**-**	**-**	**1**	**1**	**2.00**

PROFESSIONAL ELECTIVES - DOMAIN- III (ARTIFICIAL INTELLIGENCE)

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE31	Artificial Intelligence Principles And Techniques	3	0	0	3	40	60	100
2	PE	X22MCE32	Soft Computing Techniques	3	0	0	3	40	60	100
3	PE	X22MCE33	Knowledge Engineering And Expert Systems	3	0	0	3	40	60	100
4	PE	X22MCE34	Cognitive Computing	3	0	0	3	40	60	100
5	PE	X22MCE35	Natural Language Processing	3	0	0	3	40	60	100
6	PE	X22MCE36	Speech Processing	3	0	0	3	40	60	100

X22MCE31 ARTIFICIAL INTELLIGENCE PRINCIPLES AND TECHNIQUES L T P C

3 0 0 3

OBJECTIVE(S):

- To understand basic problem solving strategies.
- To outline game theory based search and constraint satisfaction
- To study knowledge representation techniques
- To explore reasoning and planning associated with AI.
- To study the techniques of knowledge representation.
- To understand probabilistic and other types of reasoning

UNIT–1 INTRODUCTIONAND PROBLEMSOLVING 9

Introduction: History Intelligent Systems, Foundations of Artificial Intelligence, Sub areas of AI, Applications of AI.Problem Solving - State - Space Search and Control Strategies: Introduction, General Problem Solving Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative - Deepening A*, Constraint Satisfaction.

UNIT–II ADVERSARIAL SEARCHA ND CONSTRAINT SATISFACTION PROBLEMS 9

Game playing – mini-max algorithm, Alpha-Beta Pruning, Constraint satisfaction problems, Backtracking search for CSP, Local search for CSP, Bounded Look - ahead Strategy and use of Evaluation Functions

UNIT–III KNOWLEDGE, REASONING AND PLANNING 9

Introduction, Approaches to knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames. Reasoning Systems for Categories, Planning problem, Planning with state-space search, partial order planning, Planning graphs, Planning with propositional logic.

UNIT IV UNCERTAINTY AND KNOWLEDGE REASONING 9

Overview – Definition of uncertainty, Bayes Rule – Inference, Belief Network, Utility Based System, Decision Network, Certainty Factor Theory, Dempster - Shafer Theory-Case Based Reasoning –Explanation-Based Learning – Evolutionary Computation.

UNIT V MACHINE LEARNING PARADIGMS 9

The Limits of AI –Introduction to Machine Learning and Deep Learning, Supervised and Unsupervised Learning, Inductive Learning, Learning Decision Trees, Deductive Learning, Knowledge in Learning –Statistical Learning Methods – Reinforcement Learning - Clustering, Support Vector Machines.

TOTAL:45

COURSE OUTCOMES:

CO1: Implement any three problem solving methods for a puzzle of your choice
CO2: Understand Game playing and implement a two player game using AI techniques
CO3: Design and Implementation example using predicate Logic
CO4: Implement case based reasoning system
CO5: Discussthe methodologies to design ethical and explainable AI systems

REFERENCES:

1. StuartRussell,PeterNorvig,"ArtificialIntelligence:AModernApproach",Pearson,4thEdition,2020.
2. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning India, First Edition,2011.
3. ZhongzhiShi"AdvancedArtificial Intelligence", WorldScientific, 2019.
4. KevinKnight,ElaineRich,ShivashankarB.Nair,"ArtificialIntelligence",McGrawHillEducation; 3rd edition,2017
5. RichardE.Neapolitan,XiaJiang,"ArtificialIntelligencewithanIntroductiontoMachineLearning",ChapmanandHall/CRC;2nddedition,2018
6. DheepakKhemani,"AfirstcourseinArtificialIntelligence",McGrawHillEducationPvtLtd.,NewDelhi,2013.
7. NilsJ.Nilsson,"ArtificialIntelligence:ANewSynthesis",MorganKaufmannPublishersInc;Second Edition,2003.

X22MCE31 – ARTIFICIAL INTELLIGENCE PRINCIPLES AND TECHNIQUES												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	1	2	3	-	-	-	-	-	-	-
CO2	1	1	1	2	3	-	-	-	-	1	-	-
CO3	1	1	1	2	-	-	-	-	-	1	-	-
CO4	1	1	1	2	3	-	-	-	-	1	-	-
CO5	1	1	1	2	3	-	-	-	-	-	-	-
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1.00**	**-**	-

X22MCE32	SOFT COMPUTING TECHNIQUES	L T P C
		3 0 0 3

OBJECTIVES:

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

UNIT I: INTRODUCTION TO SOFT COMPUTING **9**

Introduction of soft computing, soft computing vs. hard computing- various types of soft computing techniques- Requirements of Soft computing – Characteristics of Soft computing- Some applications of soft computing techniques.

UNIT II: FUNDAMENTALS OF ARTIFICIAL NEURAL NETWORKS: **9**

Introduction to Artificial neural network: characteristics- Model of Artificial Neuron, Architectures, learning methods - Evolution of neural networks- important technologies – Taxonomy of ANN Systems, SingleLayer ANN System, Supervised Learning Neural Networks, Perceptrons, Adaline, Backpropagation, MutilayerPerceptrons Applications of ANN in research. Unsupervised learning networks: Kohonenself organizing feature maps, LVQ – CP networks, ART network. Introduction to MATLAB.

UNIT III: FUZZY SET THEORY & FUZZY SYSTEMS **9**

Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, introduction & features of membership functions, Extension Principle, Fuzzy If-Then Rules, Fuzzy Inference Systems, Fuzzification, Defuzzification**,** Applications of fuzzy systems in basic medical systems.

UNIT IV: GENETIC ALGORITHM **9**

Genetic algorithm and search space - general genetic algorithm – operators - Generational cycle - stopping condition – constraints - classification - genetic programming – multilevel optimization – real life problem-advances in GA.

UNIT V: HYBRID and OTHER SOFT COMPUTING TECHNIQUES **9**

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP – Other Soft computing Techniques – Simulated Anneling, Ant colony optimization and Particle swarm optimization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course student should be able to

CO1: Comprehend machine learning and soft computing techniques in solving real world applications

CO2: Design and develop ML techniques with assistance of MATLAB

CO3: Visualize and analyze behavioural pattern to develop evolutionary algorithm

CO4: Become a MATLAB professional

CO5: Design Algorithm for classification Problems

References:

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.

X22MCE32 – SOFT COMPUTING TECHNIQUES												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	2	1	-	-	-	-	-	-	2
CO2	1	1	1	2	1	-	-	-	-	-	-	2
CO3	1	1	1	2	1	-	-	-	-	-	-	2
CO4	1	1	1	2	1	-	-	-	-	-	-	2
CO5	1	1	1	2	1	-	-	-	-	1	-	2
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**1**	**-**	**2.00**

X22MCE33 KNOWLEDGE ENGINEERING AND EXPERT SYSTEMS L T P C
3 0 0 3

OBJECTIVE(S):

- To get introduced to the basic knowledge representation, problem solving, and learning methods of Artificial Intelligence.
- To solve problems in Artificial Intelligence using Python.
- To familiarize with Fuzzy Logic and knowledge processing in expert systems.

UNIT I INTRODUCTION 9

Overview of data. Information and knowledge-Knowledge engineering and knowledge management- Artificial intelligence use in knowledge engineering- knowlwdge based system and its applications.

UNIT-II KNOWLEDGE ACQUISITION 9

Knowledge Acquisition stages – Representation schemes, Rule, Semantic network, frames and logic – Inference Techniques – Applications of Natural Language processing-Morphology, lexicon, syntax and semantics- Parsing, POS tagging, named entity tagging.

UNIT-III KNOWLEDGE REPRESENTATION AND REASONING 9

Using Predicate logic - representing facts in logic, functions and predicates, Conversion to clause form, Resolution in propositional logic, Resolution in predicate logic, Unification. Representing Knowledge Using Rules: Procedural Versus Declarative knowledge, Logic Programming, Forward versus Backward Reasoning

UNIT-IV EXPERT SYSTEMS 9

The meaning of an expert system, problem domain and knowledge domain, the advantages of an expert system, general stages in the development of an expert system, general characteristics of an expert system, history and uses of expert systems today, rule-based expert systems, procedural and nonprocedural paradigms, characteristics of artificial neural systems.

UNIT-V BUILDING AN EXPERT SYSTEM 9

Expert system development, Selection of the tool, Acquiring Knowledge, Building process. Problems with Expert Systems: Difficulties, common pitfalls in planning, dealing with domain experts, difficulties during development.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course student should be able to

CO1: Identify Expert Systems relationship and Knowledge-Based Systems

CO2: Implement the inference: abduction; deduction; induction

CO3: Identify the Rule-based, logic-based representations

CO4: Design and build expert system

CO5: Use smart tools for building expert systems

REFERENCES

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition, ISBN: 13:978-0-07-008770-5, 2010.

2. Stuart Russell, Peter Norvig, “Artificial Intelligence- A modern approach”, Pearson Education Asia, Second Edition, ISBN:81-297-0041-7.

3. J. Giarratano and G. Riley, "Expert Systems -- Principles and Programming". 4th Edition, PWS Publishing Company, 2004.

4. Durkin, J., Expert systems Design and Development, Macmillan, 1994 2. Elias M. Awad, Building Expert Systems, West Publishing Company 1996

5. Peter Jackson, Introduction to Expert Systems, Addison Wesley Longman, 1999.ISBN 0- 20187686-8.

6. Patterson, Artificial Intelligence & Expert System, Prentice Hall India,1999.

X22MCE33 – KNOWLEDGE ENGINEERING AND EXPERT SYSTEMS												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	1	2	1	-	-	-	-	-	-	2
CO2	1	1	1	2	1	-	-	-	-	-	-	2
CO3	1	1	1	2	1	-	-	-	-	-	-	2
CO4	1	1	1	2	1	-	-	-	-	-	-	2
CO5	1	1	1	2	1	-	-	-	-	1	1	2
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**-**	**-**	**-**	**-**	**1**	**1**	**2.00**

X22MCE34 **COGNITIVE COMPUTING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To familiarize Use the Innovation Canvas to justify potentially successful products.
- To learn various ways in which to develop a product idea.
- To understand about how Big Data can play vital role in Cognitive Computing
- To know about the business applications of Cognitive Computing
- To get into all applications of Cognitive Computing

UNITI FOUNDATION OF COGNITIVE COMPUTING 9

Foundation of Cognitive Computing cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition Design Principles for Cognitive System: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning hypotheses generation and scoring, presentation, and visualization services.

UNIT II NATURAL LANGUAGE PROCESSING IN COGNITIVE SYSTEMS 9

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system sematic web, Applying Natural language technologies to Business problems Representing knowledge in Taxonomies and Ontologies: Representing knowledge. Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.

UNIT III BIG DATA AND COGNITIVE COMPUTING 9

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data defining big data, architectural foundation, analytical data warehouses. Hadoop, data in motion and streaming data, integration of big data with traditional data Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, using advanced analytics to create value, impact of open source tools on advanced analytics

UNIT IV BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING 9

Preparing for change advantages of new disruptive models, knowledge meaning to business difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan for the future, answering business questions in new ways, building business specific solutions, making cognitive computing a reality, cognitive application changing the market The process of building a cognitive application: Emerging cognitive platform, defining the objective defining the domain, understanding the impended users and their attributes, questions and exploring insights, training and testing

UNIT V APPLICATION OF COGNITIVE COMPUTING 9

Building a cognitive health care application: Foundations of cognitive computing for healthcare, constituents in healthcare ecosystem, learning from patterns in healthcare Data, Building on a foundation of big data analytics, cognitive applications across the heath care ecosystem, starting with a cognitive application for health care, using cognitive applications to improve health and wellness, using a cognitive application to enhance the electronic medical record Using cognitive application to improve clinical teaching

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1: Explain applications in Cognitive Core computing EDGE
CO2: Describe Natural language processor role in Cognitive computing
CO3: Explain future directions of Cognitive Computing
CO4: Evaluate the process of taking a product to market
CO5: Comprehend the applications involved in this domain

REFERENCES

1.Judith H Hurwitz, Marcia Kautman, Adrian Bowles, "Cognitive computing and Big DataAnalytics". Wiley, 2015

2. Robert A. Wilson, Frank C. Kei "The MIT Encyclopedia of the Cognitive Sciences". The MIT Press, 1999

3.Noah D. Goodman, Joshua B. Tanenbaum, The ProbMods Contributors, "Probablistic Models of Cognition, Second Edition, 2016.

X22MCE34 – COGNITIVE COMPUTING						
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	1	1	1	1
CO2	1	3	3	1	1	1
CO3	1	3	2	2	1	1
CO4	1	3	3	1	1	1
CO5	1	2	3	3	1	1
AVG	**1.00**	**2.40**	**2.40**	**1.60**	**1.00**	**1.00**

X22MCE35 NATURAL LANGUAGE PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand basics of linguistics, probability and statistics
- To study statistical approaches to NLP and understand sequence labeling
- To outline different parsing techniques associated with NLP
- To explore semantics of words and semantic role labeling of sentences
- To understand discourse analysis, question answering and chatbots

UNITI INTRODUCTION 9

Natural Language Processing - Components Basics of Linguistics and Probability and Statistics-Words-Tokenization-Morphology-Finite State Automata

UNIT II STATISTICAL NLP AND SEQUENCE LABELING 9

N-grams and Language models -Smoothing -Text classification- Naïve Bayes classifier Evaluation - Vector Semantics - TF-IDF - Word2Vec- Evaluating Vector Models -Sequence Labeling - Part of Speech-Part of Speech Tagging -Named Entities -Named Entity Tagging

UNIT III CONTEXTUAL EMBEDDING 9

Constituency -Context Free Grammar -Lexicalized Grammars- CKY Parsing - Earley's algorithm-Evaluating Parsers -Partial Parsing - Dependency Relations- Dependency Parsing -Transition Based Graph Based

UNIT IV COMPUTATIONAL SEMANTICS 9

Word Senses and WordNet Word Sense Disambiguation - Semantic Role Labeling - Proposition Bank-FrameNet- selectional Restrictions - Information Extraction - Template F

UNIT V DISCOURSE ANALYSIS AND SPEECH PROCESSING 9

Discourse Coherence - Discourse Structure Parsing - Centering and Entity Based Coherence - Question Answering -Factoid Question Answering - Classical QA Models- Chatbots and Dialogue systems-Frame-based Dialogue Systems - Dialogue-State Architecture

TOTAL: 45 HOURS

COURSE OUTCOMES:

CO1: Understand basics of linguistics, probability and statistics associated with NLP

CO2: Implement a Part-of-Speech Tagger

CO3: Design and implement a sequence labeling problem for a given domain

CO4: Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP

CO5: Implement a simple chatbot using dialogue system concepts

REFERENCES

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" (Prentice Hall Series in Artificial Intelligence), 2020
2. Jacob Eisenstein. "Natural Language Processing", MIT Press, 2019
3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019
4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009.
5. Nitin Indurkhya, Fred J. Damerau, "Handbook of Natural Language Processing". Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010
6. Deepti Chopra, Nisheeth Joshi, "Mastering Natural Language Processing with Python", Packt Publishing Limited, 2016
7. Mohamed Zakaria Kurdi "Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax (Cognitive Science)". ISTE Ltd., 2016
8. AtefehFarzindar, Diana Inkpen, "Natural Language Processing for Social Media (Synthesis Lectures on Human Language Technologies)", Morgan and Claypool Life Sciences, 2015

X22MCE35 – NATURAL LANGUAGE PROCESSING						
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	-	2	1	-
CO2	-	1	3	2	-	3
CO3	3	2	1	-	-	2
CO4	1	-	3	-	2	-
CO5	2	2	-	1	3	1
AVG	**2.00**	**2.00**	**2.33**	**1.67**	**2.00**	**2.00**

X22MCE36 **SPEECH PROCESSING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To illustrate the concepts of speech signal representations and coding.
- To introduce speech production and related parameters of speech.
- To understand different speech modeling procedures such Markov and their implementation issues.
- To gain knowledge about text analysis and speech synthesis.

UNIT 1 FUNDAMENTALS OF SPEECH PROCESSING **9**

Introduction - Spoken Language Structure - Phonetics and Phonology - Syllables and Words-Syntax and Semantica - Probability, Statistics and Information Theory - Probability Theory-Estimation Theory-Significance Testing - Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING **9**

Overview of Digital Signal Processing Speech Signal Representations Short time Fourier Analysis - Acoustic Model of Speech Production-Linear Predictive Coding-Cepstral Processing-Formant Frequencies - The Role of Pitch - Speech Coding - LPC Coder, CELP, Vocoders.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models Definition - Continuous and Discontinuous HMMs-Practical issues -Limitations. Acoustic Modeling - Variability in the Speech Signal - Extracting Features – Phonetic Modeling - Adaptive Techniques-Confidence Measures - Other Techniques.

UNIT IV TEXT ANALYSIS **9**

Lexicon - Document Structure Detection-Text Normalization - Linguistic Analysis Homograph Disambiguation - Morphological Analysis - Letter-to-sound Conversion - Prosody-Generation schematic - Speaking Style-Symbolic Prosody- Duration Assignment - Pitch Generation

UNIT V SPEECH SYNTHESIS **9**

Attributes - Formant Speech Synthesis - Concatenative Speech Synthesis - Prosodic Modification of Speech-Source-filter Models for Prosody Modification-Evaluation of TTS Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to :

CO1: Model speech production system and describe the fundamentals of speech.

CO2: Extract and compare different speech parameters.

CO3: Choose an appropriate statistical speech model for a given application.

CO4: Design a speech recognition system.

CO5: Use different text analysis and speech synthesis techniques.

REFERENCES:

1. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", Wiley-India Edition, 2006

2. Claudio Becchetti and Lucio PrinaRicotti, "Speech Recognition", John Wiley and Sons,1999,

3. Daniel Juratsky and James H Martin, "Speech and Language Processing - An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition",Pearson Education, 2002.

4. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997

5. Lawrence Rabiner and Bling-Hwang Juang, "Fundamentals of Speech Recognition". Pearson Education, 2003.

6. Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing".California Technical Publishing. 1997.

7. Thomas F Quatieri, "Discrete-Time Speech Signal Processing - Principles and Practice". Pearson Education, 2004.

X22MCE36 – SPEECH PROCESSING						
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	2	3	1	1
CO2	3	-	2	3	1	1
CO3	3	-	2	3	1	1
CO4	3	-	2	3	1	1
CO5	3	-	2	3	1	1
AVG	**3.00**	**-**	**2.00**	**3.00**	**1.00**	**1.00**

PROFESSIONAL ELECTIVES - DOMAIN- IV (BIG DATA)

S.No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE41	Data Mining Technologies	3	0	0	3	40	60	100
2	PE	X22MCE42	Big Data Analytics	3	0	0	3	40	60	100
3	PE	X22MCE43	Deep Learning	3	0	0	3	40	60	100
4	PE	X22MCE44	Social Network Analysis	3	0	0	3	40	60	100
5	PE	X22MCE45	Reinforcement Learning	3	0	0	3	40	60	100
6	PE	X22MCE46	Data Visualization	3	0	0	3	40	60	100

X22MCE41 **DATA MINING TECHNOLOGIES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Learn to Design algorithms by employing Map Reduce technique for solving Big Data problems.
- Able to Identify similarities using appropriate measures.
- Learn to understand the problems associated with streaming data and handle them.
- Understand the algorithms for link analysis and frequent itemset mining.
- Learn different clustering techniques which can be applied in Big data

UNIT I DATA MINING AND LARGE SCALE FILES 9

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining – Distributed File Systems– Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II SIMILAR ITEMS 9

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Applications of Locality-Sensitive Hashing - Methods for High Degree of Similarities.

UNIT III MINING DATA STREAMS 9

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS 9

Page Rank –Efficient Computation – Topic Sensitive Page Rank – Link Spam – Hubs and Authorities - Market Basket Model – Apriori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Items.

UNIT V CLUSTERING 9

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non–Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems

TOTAL: 45 PERIODS

REFERENCES

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014.

2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.

3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.

4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT Press,2001.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:Design algorithms by employing Map Reduce technique for solving Big Data problems.

CO2:Identify similarities using appropriate measures.

CO3:Point out problems associated with streaming data and handle them.

CO4:Discuss algorithms for link analysis and frequent itemset mining.

CO5:Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

X22MCE41 – DATA MINING TECHNOLOGIES												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	2	-	2	-	2	1	-		2	3
CO2	1	3	2	-	2	-	1	-	2	-	-	3
CO3	-	3	2	3	2	-	-	3	-	1	3	3
CO4	1	3	2	2	1	-	3	-	1	-	-	2
CO5	-	3	2	3	1		-	2	-	-	-	3
AVG	**1.33**	**3.00**	**2.00**	**2.67**	**1.60**	**-**	**2.00**	**2.00**	**1.50**	**1.00**	**2.50**	2.80

X22MCE42 BIG DATA ANALYTICS **L T P C**
3 0 0 3

COURSEOBJECTIVES

- Understandfundamentalconceptsof BigData.
- ExploreknowledgeonDataAnalysismethods.
- BeFamiliarwith predictiveanalytics andvisualizationtools.
- GainKnowledge onStreaminginbig data.
- Learn Bigdataanalytics frameworks

UNITI INTRODUCTIONTOBIGDATA **9**

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs TraditionalData-RisksofBigData–Structure of BigData-ChallengesofConventionalSystems-WebData – EvolutionofAnalyticScalability-EvolutionofAnalyticProcesses,Toolsandmethods-Analysisvs Reporting-ModernData AnalyticTools.

UNITII DATA ANALYSIS **9**

Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & KernelMethods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, PartitioningMethods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model BasedClusteringMethods,ClusteringHighDimensionalData

UNITIII PREDICTIVEANALYTICSANDVISUALIZATION **9**

PredictiveAnalytics–Supervised–Unsupervisedlearning–Neuralnetworks–Kohonenmodels – Normal – Deviations from normal patterns – Normal behaviours –Mining Frequent itemsets -Market based model – Handling large data sets in Main memory – Limited Pass algorithm –Countingfrequent itemsetsinastream–KMeans–Clusteringhighdimensionaldata Visualizations-Visualdata analysistechniques-Interactiontechniques

UNITIVMININGDATASTREAMS **9**

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - MiningDataStreamsandMiningTime-seriesdata- RealTimeAnalyticsPlatform(RTAP)Applications-Case Studies-RealTimeSentimentAnalysis,StockMarketPredictions

Unit V BIG DATA FRAMEWORKS **9**

Introduction to NoSQL Databases - Apache Cassandra – Features of Cassandra – Data Types – CRUD Operations – Collections – Counter – Alter Commands – Import and Export – Querying System Tables – Hive Architecture – Data Types – File Format – Hive Query Language – Pig – Features – Pig Latin Overview – Data Types – Running and Execution Modes – Relational Operators – Eval Function – Complex Data Types - Hbase – Data Model and Implementations – Hbase Clients – ZooKeeper – Characteristics – Group Management.

Total:45Periods

COURSE OUTCOMES

Attheend ofthecoursethestudentsareableto

CO 1: Realizehowtoleveragetheinsights frombigdataanalytics

CO 2: Analyzedatabyutilizingvariousstatisticalanddataminingapproaches

CO 3:Performanalyticsonreal-timestreamingdata.

CO 4: Apply different predictive analysis and visualization techniques

CO 5: ImplementDataanalyticsusing different frameworks.

REFERENCES:

1. BillFranks, —TamingtheBigDataTidalWave:FindingOpportunities inHugeDataStreamswithAdvancedAnalytics,WileyandSASBusiness Series,2012.
2. DavidLoshin,"BigDataAnalytics:From StrategicPlanningtoEnterpriseIntegrationwithTools,Techniques,NoSQL,andGraph",2013.
3. MichaelBerthold,DavidJ.Hand,—IntelligentDataAnalysis,Springer,SecondEdition,2007.
4. MichaelMinelli,MichelleChambers,andAmbigaDhiraj,"BigData,BigAnalytics:EmergingBusinessIntelligenceandAnalytic TrendsforToday'sBusinesses",Wiley,2013.
5. Seema Acharya, SubhashiniChellappan, “Big Data and Analytics”, Wiley Publications, First Edition, 2015

X22MCE42 – BIG DATA ANALYTICS												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	3	-	-	-	-	-	-	-
CO2	3	2	-	-	3	-	-	-	-	-	1	-
CO3	3	-	3	-	-	2	-	-	-	-	-	-
CO4	3	-	-	-	-	2	-	-	-	-	1	-
CO5	3	-	-	-	-	2	-	-	2	1	-	-
AVG	**3.00**	**2.00**	**3.00**	**-**	**3.00**	**2.00**	**-**	**-**	**2.00**	**1.00**	**1.00**	-

X22MCE43 **DEEP LEARNING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS 6

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS 9

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK 10

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. RCNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO.

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN 10

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Cooccurrence Statistics–based Word Vectors. Bidirectional RNNs (BRNN) .Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data

CO2: Implement Image Segmentation and Instance Segmentation in Images

CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)

CO4: Traffic Information analysis using Twitter Data

CO5: Autoencoder for Classification & Feature Extraction

REFERENCES

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017

2. Learn Keras for Deep Neural Networks, JojoMoolayil, Apress,2018

3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020

4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017

5. Pro Deep Learning with TensorFlow, SantanuPattanayak, Apress,2017

X22MCE43 – DEEP LEARNING												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	3	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	-	-	-	2	-	-	-	-	1	-
CO4	3	-	-	-	-	2	-	-	-	-	-	-
CO5	3	-	3	-	-	-	-	-	-	-	-	-
AVG	**3.00**	**2.00**	**3.00**	**-**	**3.00**	**2.00**	**-**	**1.00**	**-**	**-**	**1.00**	-

X22MCE44	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES

- Understandtheconceptofsemanticwebandrelatedapplications.
- Learnknowledgerepresentationusingontology.
- Understand human behavior in social web and related communities
- Learnvisualizationofsocial networks.

UNITI: INTRODUCTION **9**

Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web –Emergenceof theSocialWeb –Social Networkanalysis:Developmentof Social NetworkAnalysis – Key concepts and measures in network analysis – Electronic sources for networkanalysis: Electronic discussion networks, Blogs and online communities – Web-based networks –ApplicationsofSocialNetworkAnalysis.

UNITII: MODELLING,AGGREGATINGANDKNOWLEDGE REPRESENTATION **9**

Ontology and their rolein the Semantic Web:Ontology-based knowledge Representation –Ontology languages for the Semantic Web: Resource Description Framework – Web OntologyLanguage – Modelling and aggregating social network data: State-of-the-art in network datarepresentation – Ontological representation of social individuals – Ontological representation ofsocialrelationships– Aggregatingandreasoningwithsocialnetworkdata–Advancedrepresentations.

UNITIII:EXTRACTIONANDMINING COMMUNITIESINWEBSOCIALNETWORKS **9**

Extracting evolution of Web Community from a Series of Web Archive – Detecting communitiesinsocialnetworks–Definitionofcommunity–Evaluatingcommunities–Methodsforcommunity detection and mining – Applications of community mining algorithms – Tools for detectingcommunitiessocialnetworkinfrastructuresandcommunities–Decentralizedonlinesocialnetworks– Multi-Relationalcharacterizationofdynamicsocialnetworkcommunities.

UNITIV: PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES **9**

Understandingandpredictinghuman behaviourforsocialcommunities–Userdatamanagement– Inference and Distribution – Enabling new human experiences – Reality mining – Context –Awareness– Privacyinonlinesocialnetworks–Trustinonlineenvironment–Trust modelsbasedon subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust andreputation– Trustderivationbasedontrustcomparisons–Attack spectrumandcountermeasures.

UNITV:V ISUALIZATION AND APPLICATIONSOFSOCIALNETWORKS **9**

Graphtheory–Centrality–Clustering–Node-EdgeDiagrams–Matrixrepresentation– Visualizingonlinesocialnetworks,Visualizingsocialnetworkswithmatrix-basedrepresentations – Matrix and Node-Link Diagrams – Hybrid representations – Applications –**A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments-Real Time Emotion Classification of Tweets**

Total:45periods

COURSEOUTCOMES

At the end of the course the students are able to
CO1:Develop semanticwebrelated applications.
CO2: Representknowledge using ontology.
CO 3: Apply mining algorithms on Social Networks
CO 4: Predicthumanbehaviourinsocialwebandrelatedcommunities.
CO5: Visualizesocialnetworks and apply in real time applications

REFERENCEBOOKS:

1. Social Network Analysis: Theory and Applications Mohammad GouseGalety (Editor), Chiai Al Atroshi (Editor), BuniBalabantaray (Editor), Sachi Nandan Mohanty (Editor), 2022.
2. PeterMika,"SocialNetworksandtheSemanticWeb",,FirstEdition,Springer2007.
3. BorkoFurht,"HandbookofSocialNetworkTechnologiesandApplications",1stEdition,Springer,2010.
4. GuandongXu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking –Techniques andapplications",FirstEditionSpringer,2011.
5. Dion Goh and Schubert Foo, "Social information Retrieval Systems: EmergingTechnologies and Applications for Searching the Web Effectively", IGI Global Snippet,2008.
6. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and SocialInformationRetrievalandAccess:TechniquesforImproveduserModelling",IGIGlobalSnippet,2009.
7. JohnG.Breslin,Alexandre Passantand StefanDecker,"TheSocialSemanticWeb",Springer,2009.

X22MCE44 – SOCIAL NETWORK ANALYSIS												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	2	-	3	-	1	1	1	2	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-
CO3	2	1	-	1	3	2	-	2	1	-	2	-
CO4	3	-	-	-	-	-	-	-	1	-	-	-
CO5	3	-	3	-	-	-	-	-	-	-	-	-
AVG	**2.80**	**1.50**	**3.00**	**2.00**	**3.00**	**2.50**	**-**	**1.50**	**1.00**	**1.00**	**2.00**	-

X22MCE45 **REINFORCEMENT LEARNING** **L T P C**
3 0 0 3

Course Pre-requisites: Probability and Linear Algebra (Basics), Programming Knowledge (preferably Python), Data Structures and Algorithms, Artificial Intelligence, Machine Learning and (Deep) Neural Networks

COURSE OBJECTIVES:

- Learn how to define RL tasks and the core principals behind the RL
- Implement in code common algorithms following code standards and libraries used in RL
- Understand and work with approximate solutions
- Learn the policy gradient methods
- Explore imitation learning tasks and solutions

UNIT I INTRODUCTION **9**

Reinforcement Learning - Elements of Reinforcement Learning - Limitations and Scope - History of Reinforcement Learning - **Multi-arm Bandits:** An n-Armed Bandit Problem - Action-Value Methods - Incremental Implementation - Tracking a Nonstationary Problem- Optimistic Initial Values - Upper-Confidence-Bound Action Selection - Gradient Bandits.

UNIT II FINITE MARKOV DECISION PROCESSES **9**

The Agent–Environment Interface - Goals and Rewards Returns - Unified Notation for Episodic and Continuing Tasks - The Markov Property - Markov Decision Processes - Value Functions - Optimal Value Functions - Optimality and Approximation

UNIT III DYNAMIC PROGRAMMING AND MONTE CARLO METHODS 9

Policy Evaluation - Policy Improvement - Policy Iteration - Value Iteration - Asynchronous Dynamic Programming - Generalized Policy Iteration - Efficiency of Dynamic Programming. Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control - Monte Carlo Control without Exploring Starts

UNIT IV TEMPORAL-DIFFERENCE LEARNING AND ELIGIBILITY TRACES **9**

TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - Sarsa: On-Policy TD Control - Q-Learning: Off-Policy TD Control - Games, After states, and Other Special Cases. n-Step TD Prediction - The Forward View of TD(λ) - The Backward View of TD(λ) - Equivalences of Forward and Backward Views - Sarsa(λ) - Watkins's Q(λ).

UNIT V POLICY APPROXIMATION AND APPLICATIONS 9

Actor–Critic Methods - Eligibility Traces for Actor–Critic Methods - R-Learning and the Average-Reward Setting. TD-Gammon - Samuel's Checkers Player - The Acrobot - Elevator Dispatching - Dynamic Channel Allocation - Job-Shop Scheduling- Applications of Reinforcement Learning.

TOTAL PERIOD: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students are able to

CO1: Understand the basics of Reinforcement Learning

CO2: Apply Markov decision process

CO3: Implement Dynamic Programming and Monte Carlo Methods

CO4: Understand Temporal-Difference Learning and Eligibility Traces

CO5: Analyze Policy Approximation in R Learning

Reference Books:

1. Richard S. Sutton and Andrew G. Barto; Reinforcement Learning: An Introduction; 2nd Edition, MIT Press, 2020. [TEXTBOOK]
2. Dimitri P. Bertsekas; Reinforcement Learning and Optimal Control; 1st Edition, Athena Scientific, 2019.
3. Goodfellow, Ian, YoshuaBengio, and Aaron Courville. "Deep learning." MIT press, 2016.
4. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach." Pearson Education Limited, 2016.
5. CsabaSzepesvári; Algorithms of Reinforcement Learning; Synthesis Lectures on Artificial Intelligence and Machine Learning, vol. 4, no. 1, 2010.
6. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012):

X22MCE45 – REINFORCEMENT LEARNING												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	3	-	1	-	2	-	-	-
CO2	3	-	-	-	-	-	-	1	-	2	-	-
CO3	3	2	-	-	-	2	-	-	-	-	1	-
CO4	3	-	-	-	-	2	-	1	-	2	-	-
CO5	3	-	3	-	1	-	1	-	2	-	2	-
AVG	**1.00**	**1.00**	**1.00**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1.00**	**-**	-

X22MCE46 **DATA VISUALIZATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis. 55
- To understand technological advancements of data visualization
- To understand various data visualization techniques
- To understand the methodologies used to visualize large data sets

UNIT I INTRODUCTION AND DATA FOUNDATION 9

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets

UNIT II FOUNDATIONS FOR VISUALIZATION 9

Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.

UNIT III VISUALIZATION TECHNIQUES 10

Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques – Line Based Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.

UNIT IV INTERACTION CONCEPTS AND TECHNIQUES 10

Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.

UNIT V RESEARCH DIRECTIONS IN VISUALIZATIONS 7

Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation, Hardware and Applications

TOTAL PERIODS: 45 HOURS

COURSE OUTCOMES:

CO1: Visualize the objects in different dimensions.

CO2: Design and process the data for Visualization.

CO3: Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.

CO4: Apply the virtualization techniques for research projects.

CO5: Identify appropriate data visualization techniques given particular requirements imposed by the data.

REFERENCES

1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010. 56

2. Colin Ware, "Information Visualization Perception for Design", 4th edition, Morgan Kaufmann Publishers, 2021.

3. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2nd Edition, 2007.

4. Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008.

X22MCE46 – DATA VISUALIZATION												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	3	-	-	-	1	-	2	-
CO2	3	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	-	-	-	2	-	-	-	-	1	-
CO4	3	-	-	-	-	2	-	2	1	-	-	-
CO5	3	-	3	-	1	2	1	1	2	-	-	-
AVG	**3.00**	**2.00**	**3.00**	**-**	**2.00**	**2.00**	**1.00**	**1.33**	**1.33**	**-**	**1.50**	-

PROFESSIONAL ELECTIVES - DOMAIN- V (IMAGE PROCESSING)

S. No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE51	Digital Image Processing	3	0	0	3	40	60	100
2	PE	X22MCE52	Multimedia Coding Techniques	3	0	0	3	40	60	100
3	PE	X22MCE53	Computer Vision	3	0	0	3	40	60	100
4	PE	X22MCE54	Pattern Recognition	3	0	0	3	40	60	100
5	PE	X22MCE55	Video Analytics	3	0	0	3	40	60	100
6	PE	X22MCE56	Principles of Sensors	3	0	0	3	40	60	100

X22MCE51 **DIGITAL IMAGE PROCESSING** **L T P C**

3 0 0 3

PREREQUISITE: NIL

OBJECTIVES:

- To study fundamental concepts of digital image processing.
- To understand and learn image processing operations and restoration.
- To use the concepts of Feature Extraction
- To study the concepts of Image Compression.
- To expose students to current trends in the field of image segmentation

UNIT I – DIGITAL IMAGE FUNDAMENTALS **9**

Introduction – Origin –Steps in Digital Image Processing – Components; Elements of Visual Perception – Light and Electromagnetic Spectrum – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels.

UNIT II – IMAGE ENHANCEMENT **9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

UNIT III – IMAGE RESTORATION **9**

Noise models – Mean filters – Order Statistics – Adaptive filters – Band reject – Band pass – Notch – Optimum notch filtering – Inverse Filtering – Constrained Least Square Filtering – Wiener filtering. Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation

UNIT IV – IMAGE COMPRESSION **9**

Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding –Bit – Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding –Wavelet Coding – Compression Standards – JPEG2000.

UNIT V – IMAGE SEGMENTATION **9**

Segmentation – Detection of Discontinuities – Edge Linking and Boundary detection – Region based segmentation. Object Recognition: Patterns and patterns classes, recognition based on decision– theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching, Case studies–Various Image Processing Techniques.

TOTAL PERIODS :45

COURSE OUTCOMES:

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

CO1: Apply knowledge of Mathematics for image processing operations

CO2: Apply techniques for image restoration.

CO3: Identify and extract salient features of images.

CO4: Apply the appropriate tools for image compression and analysis.

CO5: Apply segmentation techniques and do object recognition.

REFERENCES:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Pearson Education, fourth Edition ,2020

2. Jayaraman S., Esaki Rajan S., T.Veera Kumar, "Digital Image Processing", Tata McGraw Hill Pvt. Ltd., Second Reprint, 2010.

3. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

4. Malay K.Pakhira, "Digital Image Processing and Pattern Recognition", PHI Learning Pvt.Ltd., First Edition ,2011.

X22MCE51 – DIGITAL IMAGE PROCESSING												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	2	1	1	2	-	-	-	-	-	-	-
CO2	1	3	1	-	-	1	-	-	-	-	-	-
CO3	2	2	3	2	2	-	-	-	-	-	-	-
CO4	1	2	2	3	2	2	-	-	-	-	-	-
CO5	3	1	1	1	-	3	-	-	-	-	-	-
AVG	**1.16**	**1.66**	**1.50**	**1.16**	**1.00**	**1.00**	**-**	**-**	**-**	**-**	-	-

X22MCE52 **MULTIMEDIA CODING TECHNIQUES** ` **L T P C**

3 0 0 3

OBJECTIVE(S)

- To understand the importance of multimedia in today's online and offline information sources and repositories.
- To understand how Text, Audio, Image and Video information can be represented digitally in a computer, so that it can be processed, transmitted and stored efficiently.
- To understand the possibility and limitations of multimedia data compression.
- To understand the basic audio coding techniques including predictive coding and more advanced techniques based around LPC and sub-band coding.
- To understand bi-level Image lossless coding techniques and how these can be extended to code grayscale images and color images.

UNIT I INTRODUCTION **9**

Multimedia Representation - Text, Audio, Image and Video Representation - Input and Output Transducers - Human Vision and Audio Systems and their Limitations - Sampling, Quantization, Coding, Companding.

UNIT II BASIC CODING TECHNIQUES **9**

Introduction to Data Compression - Information Theory -Statistical Coding - Dictionary Based Coding – Audio Coding.

UNIT III LOSSLESS IMAGE CODING **9**

Bi-Level -Reflected Gray Codes - Predictive Coding –GIF-Lossless JPEG

UNIT IV LOSSY IMAGE CODING **9**

Distortion Measures -Transform Coding -JPEG -Wavelet Coding -Sub-band Coding - JPEG2000 - Progressive Image Coding.

UNIT V VIDEO CODING (LOSSY) **9**

Video Coding Concepts - The Hybrid DPCM/DCT algorithm-Motion Compensated Prediction- Motion Estimation-Standards: H.261, MPEG-1,2,4,7.

TOTAL: 45

COURSE OUTCOMES:

On successful completion of course, student will be able to

CO1: Describe the multimedia representation.
CO2: Describe the data compression.
CO3: Describe the fundamental principles of lossless and lossy coding.
CO4: Apply video coding algorithms.

CO5: Describe the multimedia representation.

REFERENCES:

1. Ze-Nian Li & Mark Drew, “Fundamentals of Multimedia”, Prentice Hall, 2004.

2. Yun Q. Shi, Huifang Sun, “Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards”, CRC Press, Second edition, 2008

3. B.Prabhakaran, “Multimedia Database Management Systems”, Springer International Edition, 2007.

4. Tay Vaughan, “Multimedia: Making it Work”, McGraw Hill Publication, Eighth Edition, 2010.

5. Charles Marsh, David W.Guth, B.PShort, “Strategic Writing: Multimedia writing for Public Relations, Advertising and More”, Pearson education, Second Edition, 2008.

X22MCE52 – MULTIMEDIA CODING TECHNIQUES												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	2	3	-	-	-	-	1	-	3
CO2	1	1	-	2	3	-	-	-	-	1	-	2
CO3	1	1	-	2	3	-	-	-	-	1	-	2
CO4	1	1	-	2	3	-	-	-	-	1	-	2
CO5	1	1	-	2	3	-	-	-	-	1	-	2
AVG	**1.00**	**1.00**	**-**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1**	**-**	2

X22MCE53 **COMPUTER VISION** **L T P C**
3 0 0 3

OBJECTIVE(S):

- To become familiar with the major technical approaches involved in computer vision.
- To describe various methods used for registration, alignment, and matching in images.
- To perform shape analysis and extract features form Images and do analysis of Images
- To get an exposure to advanced concepts, including state of the art deep learning architectures, in all aspects of computer vision.

UNIT I EARLY VISION-JUST ONE IMAGE **9**

Linear Filters: Linear Filters and Convolution- Shift Invariant Linear Systems-Spatial Frequency and Fourier Transforms-Sampling and Aliasing-Filters as Templates-Finding Patterns-Scale and Image Pyramids. Local Image Features: Computing the Image Gradient-Representing Image Gradient-Finding Corners and Building Neighborhoods-SIFT and HOG Features.Texture: Local Texture Representations using Filters-Discovering Textons-Synthesizing Textures and Filling Holes in Images-Image Denoising-Shape from Texture

UNIT II EARLY VISION-MULTIPLE IMAGES **9**

Stereopsis: Binocular Camera Geometry and the Epipolar Constraint-Binocular Reconstruction-Human Stereopsis-Local Methods for Binocular Fusion-Global Methods for Binocular Fusion-Using more cameras. Structure from Motion: Internally Calibrated Perspective Cameras- Uncalibrated Weak-Perspective Cameras- Uncalibrated Perspective Cameras.

UNIT III MID-LEVEL VISION **9**

Segmentation by Clustering: Human Vision: Grouping and Gestalt-Important Applications-Image Segmentation by Clustering Pixels-Segmentation, Clustering and Graphs. Grouping and Model Fitting: The Hough Transform-Fitting Lines and Planes-Fitting Curved Structures-Robustness-Fitting Using Probabilistic Models-Motion Segmentation by Parameter Estimation. Tracking: Simple Tracking Strategies-Tracking Using Matching-Tracking Linear Dynamical Models with Kalman Filters-Data Association-Particle Filtering.

UNIT IV HIGH-LEVEL VISION **9**

Registration-Smooth Surfaces and Their Outlines-Range Data-Learning to Classify-Classifying Images-Detecting Objects in Images-Object Recognition

UNIT V APPLICATIONS **9**

Image-Based Modeling and Rendering: Visual Hulls-Patch-Based Multi-View Stereopsis-The Light Field. Looking At People: HMM's, Dynamic Programming and Tree-Structured Models- Parsing People in Images- Tracking People- 3D from 2D Lifting-Activity Recognition. Image search and Retrieval: The Application context-Basic Technologies from Information Retrieval –Images as documents- Predicting Annotations from Pictures-The State of the art of Word prediction

TOTAL: 45

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1. Implement common methods for robust image matching and alignment.

CO2. Understand the geometric relationships between 2D images and the 3D world.

CO3. Gain exposure to object and scene recognition and categorization from images.

CO4. Develop the practical skills necessary to build computer vision applications.

CO5. Apply knowledge of computer vision to real life scenarios.

REFERENCES

1. "Computer Vision - A modern approach", D. Forsyth and J. Ponce, Prentice Hall, 2012
2. "Computer Vision: Algorithms and Applications (CVAA)", Richard Szeliski, Springer, 2010
3. "Computer Vision" – Ballard and Brown, Prentice Hall, 1982
4. "Computer & Machine Vision", E. R. Davies, Academic Press, 2012

X22MCE53 – COMPUTER VISION												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	2	3	-	-	-	-	1	-	3
CO2	1	1	-	2	3	-	-	-	-	1	-	2
CO3	1	1	-	2	3	-	-	-	-	1	-	2
CO4	1	1	-	2	3	-	-	-	-	1	-	2
CO5	1	1	-	2	3	-	-	-	-	1	-	2
AVG	**1.00**	**1.00**	**-**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1**	**-**	2

X22MCE54 **PATTERN RECOGNITION** **L T P C**

3 0 0 3

OBJECTIVE(S):

- To learn the fundamentals of Pattern Recognition techniques.
- To choose an appropriate feature classification algorithm for pattern recognition problems and apply them properly using modern computing tools such as Matlab, C/C++ etc.
- To learn the various Statistical Pattern recognition techniques.
- To learn the various Syntactical Pattern recognition techniques.
- To learn the Neural Pattern recognition techniques.

UNIT I: INTRODUCTION AND CLASSIFIERS BASED ON BAYES DECISION THEORY **9**

Is Pattern Recognition Important?-Features,Features Vectors and Classifiers-Supervised, Unsupervised and Semi-Supervised Learning-Bayes decision Theory-Discriminant Functions and Decision surfaces-Bayesian Classification for Normal Distributions-Estimation of unknown Probability Density Functions-The Nearest Neighbor Rule-Bayesian Networks.

UNIT II: LINEAR CLASSIFIERS AND NONLINEAR CLASSIFIERS **9**

Linear Discriminant Functions and Decision Hyperplanes – The Perceptron Algorithm-Least square Methods-Mean Square Estimation Revisited-Logistic Discrimination-Support Vector Machines- The XOR Problem-The Two-Layer Perceptron-Three-Layer Perceptrons-Algorithms Based on Exact Classification of the Training Set-Decision Trees-Combining Classifiers.

UNIT III: FEATURE SELECTION **9**

Introduction-Preprocessing-The Peaking Phenomenon-Feature Selection Based on Statistical Hypothesis Testing-ROC Curve-Class Separability Measures-Feature Subset Selection-Optimal Feature Generation-Neural Networks and Feature Generation/Selection-The Bayesian Information Criterion.

UNIT IV: FEATURE GENERATION I AND FEATURE GENERATION II **9**

Introduction –Basic Vectors and Images-The Karhunen-Loeve Transform-The Singular Value Decomposition-Independent Component Analysis-Nonnegative Matrix Factorization-NonLinear Dimensionality Reduction-DFT-The Discrete Cosine and Sine Transform-The Hadamard Transform-The Haar Transform-DTWT-The Multiresolution Interpretation-Wavelet Packets.Regional Features-Features of Shape and Size characterization-A Glimpse at Fractals-Typical features for Speech and Audio Classification.

UNIT V: TEMPLATE MATCHING AND CONTEXT-DEPENDENT CLASSIFICATION **9**

Introduction-Measures Based on Optimal Path Searching Techniques-Measures Based on Correlations-Deformable Template Models-Content Based Information Retrieval-The Bayes Classifier-Markov Chain Models-The Viterbi Algorithm-Channel Equalization-Hidden Markov Models-HMM with State Duration Modeling-Training Markov Models via Neural Networks.

TOTAL: 45

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1. Understand basic structure of pattern recognition systems.

C02. Understand the nature and inherent difficulties of the pattern recognition problems

CO3. Understand concepts, trade-offs, and appropriateness of the different feature types and classification techniques such as Bayesian, maximum-likelihood, etc

CO4. Select a suitable classification process, features, and proper classifier to address a desired pattern recognition problem.

CO5. Select the applications of pattern recognition in various applications.

REFERENCE BOOKS

1. "Pattern Recognition", Theodoridis, S. and K. Koutroumbas, Fourth Edition, Elsevier Inc.,2009
2. "Pattern Classification" – R.O. Duda, P.E. Hart and D.G. Stork, Second Edition John Wiley, 2006
3. "Pattern Recognition and Machine Learning" – C. M. Bishop, Springer, 2009.
4. "Pattern Recognition and Image Analysis", Earl Gose, Richard Johnsonbaugh and Steve Jost, Prentice Hall of India, 2002.

X22MCE54 – PATTERN RECOGNITION												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	2	3	-	-	-	-	1	-	3
CO2	1	1	-	2	3	-	-	-	-	1	-	2
CO3	1	1	-	2	3	-	-	-	-	1	-	2
CO4	1	1	-	2	3	-	-	-	-	1	-	2
CO5	1	1	-	2	3	-	-	-	-	1	-	2
AVG	**1.00**	**1.00**	**-**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1**	**-**	2

X22MCE55	VIDEO ANALYTICS	L T P C
		3 0 0 3

OBJECTIVE(S):

- To understand the real time use of video analytics.
- To demonstrate real time video analytics applications and others.
- To understand the basic concepts of video compression formats.
- To understand the basic concepts of vehicle tracking objects. .
- To understand the basic concepts of object tracking algorithms.

UNIT 1: VIDEO SURVEILLANCE CAMERAS **9**

Introduction -Constraints -Financial constraints - Environmental constraints -Nature of the information captured-Spectral bands -3D or "2D + Z" imaging-Video formats -Technologies - Interfaces: from analog to IP-From analog to digital-The advent of IP Standards-Smart cameras

UNIT II: VIDEO COMPRESSION FORMATS **9**

Introduction - Video formats- Analog video signals- Digital video: standard definition-High definition-The CIF group of formats-Principles of video compression-Spatial redundancy- Temporal redundancy- Compression standards-MPEG- MPEG-4 Part 2- MPEG-4 Part 10/H.264 AVC- MPEG-4 Part 10/H.264 SVC- Motion JPEG 2000.

UNIT III: COMPRESSED DOMAIN ANALYSIS FOR FAST ACTIVITY DETECTION **9**

Introduction- Processing methods-Use of transformed coefficients in the frequency domain-. Use of motion estimation-Hybrid approaches-Uses of analysis of the compressed domain-General architecture-Functions for which compressed domain analysis is reliable-Limitations.Detection of Objects of Interest- Moving object detection- Object detection using background modeling- Motion-based detection of objects of interest- Detection by modeling of the objects of interest- Detection by geometric modeling - Detection by visual modeling.

UNIT IV: TRACKING OF OBJECTS OF INTEREST IN A SEQUENCE OF IMAGES **9**

Introduction- Representation of objects of interest and their associated visual features-. Geometry- Characteristics of appearance- Geometric workspaces- Object-tracking algorithms- Deterministic approaches- Probabilistic approaches- Updating of the appearance models- Multi-target tracking- MHT and JPDAF-. Interactive filters, track graph- Object tracking using a single PTZ camera only- Object tracking using a PTZ camera coupled with a static camera.

UNIT V : TRACKING OBJECTS OF INTEREST THROUGH A CAMERA NETWORK **9**

Introduction- Tracking in a network of cameras whose fields of view overlap- Introduction and applications- Calibration and synchronization of a camera network- Description of the scene by multi-camera aggregation- Tracking through a network of cameras with non-overlapping fields of view- Issues and applications- Geometric and/or photometric calibration of a camera network- Reidentification of objects of interest in a camera network- Activity recognition/event detection in a camera network- Biometric Techniques Applied to Video Surveillance- Vehicle Recognition in Video Surveillance-. Activity Recognition- Analysis of Crowded Scenes in Video.

TOTAL: 45

COURSE OUTCOMES:

CO1. Describe the fundamental principles of image.

CO2. Describe Fundamentals of filtering.

CO3. Describe the fundamental principles of video analysis and have an idea of their applications.

CO4. Apply image and video analysis approaches to solve real world problems.

CO5. Synchronize multi-camera crowded scenes.

REFERENCES

1. "Intelligent Video Surveillance Systems ", Jean-Yves Dufour (Editor),WILEY,FEB 2013.
2. "Video Analytics for Business Intelligence", Caifeng Shan, FatihPorikli,TaoXiang,Shaogang Gong 2012 Springer 2012
3. Systems: Technologies and Applications AsierPerallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio GarcíaZuazola 2015 Wiley,2015
4. "Digital Video Processing", A.MuratTekalp,secondedition, Pearson,2015

X22MCE55 – VIDEO ANALYTICS												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	2	3	-	-	-	-	1	-	3
CO2	1	1	-	2	3	-	-	-	-	1	-	2
CO3	1	1	-	2	3	-	-	-	-	1	-	2
CO4	1	1	-	2	3	-	-	-	-	1	-	2
CO5	1	1	-	2	3	-	-	-	-	1	-	2
AVG	**1.00**	**1.00**	**-**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1**	**-**	2

X22MCE56 **PRINCIPLES OF SENSORS** **L T P C**
3 0 0 3

OBJECTIVE(S):

- To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated,characterised, and analysed.
- To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors for measuring velocity and acceleration
- To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.
- To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure .

UNIT I **9**

Sensor fundamentals and characteristics -Sensor Classification, Performance and Types, Error Analysis characteristics- Optical Sources and Detectors -Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers-Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photodiodes, Avalanche photodiodes, CCDs.

UNIT II **9**

Intensity Polarization and Interferometric Sensors-Intensity sensor, Microbending concept, Interferometers, Mach Zehnder, Michelson, FabryPerot and Sagnac, Phase sensor: Phase detection, Polarization maintaining fibers.Strain, Force, Torque and Pressure sensors -Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor-Piezo-resistive and capacitive pressure sensor.

UNIT III **9**

Optoelectronic pressure sensors, vacuum sensors- Position, Direction, Displacement and Level sensors-Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magneto strictive sensors. Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor.

UNIT IV **9**

Velocity and Acceleration sensors-Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics,capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithicand optical gyroscopes.

UNIT V **9**

Flow, Temperature and Acoustic sensors-Flow sensors: pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. microflow sensor, coriolis mass flow and drag flow sensor. Temperature sensors- thermoresistive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor. Acoustic sensors- microphones-resistive, capacitive, piezoelectric, fiber optic, solid state -electrect microphone.

TOTAL: 45

COURSE OUTCOMES:

On successful completion of course, student will be able to

CO1. Use concepts in common methods for converting a physical parameter into an electrical quantity

CO2. Choose an appropriate sensor comparing different standards and guidelines to make sensitive

CO3.Measurements of physical parameters like pressure, flow, acceleration, etc

CO4.Design and develop sensors using optical methods with desired properties

CO5.Evaluate performance characteristics of different types of sensors

CO6.Locate different type of sensors used in real life applications and paraphrases their Importance

CO7.Create analytical design and development solutions for sensors.

REFERENCES:

1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2015, 3rd Edition, Springer, New York.

2. Jon. S. Wilson, “Sensor Technology Hand Book”, 2011, 1st edition, Elsevier, Netherland.

GerdKeiser,”Optical Fiber Communications”, 2012, 4th edition, McGraw-Hill Science, Delhi.

3. John G Webster, “Measurement, Instrumentation and sensor Handbook”, 2014, 2nd edition, CRC Press, Florida.

4. Eric Udd and W.B. Spillman, “Fiber optic sensors: An introduction for engineers and scientists”, 2013, 2nd edition, Wiley, New Jersey.

5. Bahaa E. A. Saleh and Malvin Carl Teich, “Fundamentals of photonics”, 2012, 1st edition, John Wiley, New York.

X22MCE56 – PRINCIPLE OF SENSORS												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	2	3	-	-	-	-	1	-	3
CO2	1	1	-	2	3	-	-	-	-	1	-	2
CO3	1	1	-	2	3	-	-	-	-	1	-	2
CO4	1	1	-	2	3	-	-	-	-	1	-	2
CO5	1	1	-	2	3	-	-	-	-	1	-	2
AVG	**1.00**	**1.00**	**-**	**2.00**	**3.00**	**-**	**-**	**-**	**-**	**1**	**-**	2

PROFESSIONAL ELECTIVES - DOMAIN- VI (SOFTWARE ENGINEERING)

S.No	CAT	COURSE CODE	COURSE TITLE	L	T	P	C	MARKS		
								CA	EA	TOT
THEORY										
1	PE	X22MCE61	Advanced Software Engineering	3	0	0	3	40	60	100
2	PE	X22MCE62	Software Test Automation	3	0	0	3	40	60	100
3	PE	X22MCE63	Software Security	3	0	0	3	40	60	100
4	PE	X22MCE64	Integrated Software Project Management	3	0	0	3	40	60	100
5	PE	X22MCE65	Software Reliability Metrics & Modelling	3	0	0	3	40	60	100
6	PE	X22MCE66	Software Verification And Validation	3	0	0	3	40	60	100

X22MCE61	ADVANCED SOFTWARE ENGINEERING	L T P C 3 0 0 3

OBJECTIVES

- To comprehend software development process and formal specifications
- To know advanced software development techniques and its application in real world context
- To understand how to manage complex projects
- To use advanced software testing techniques
- To understand process improvement and re engineering

UNIT I PROCESS MODELS **9**

Prescriptive process models – Specialized process models –The Unified Process – Personal and team Software process – Product and Process – Agile development – Extreme Programming –Other Agile process models – Human aspects of Software Engineering

UNIT II REQUIREMENTS MODELING AND DESIGN CONCEPTS **9**

Understanding Requirements–Scenario based methods–Class based methods–Behavior, Patternsand Web/Mobile Apps – Design Process – Design concepts – Design Model

UNIT III SOFTWARE DESIGN **9**

Architectural design–Component level Design–User Interface Design–Pattern based design–WebApp design– Mobile App design

UNIT IV ADVANCED SOFTWARE TESTING TECHNIQUES **9**

Software Review – Testing Strategies - Testing Conventional Applications – Testing Object-Oriented Applications – Testing Web Applications – Formal Modeling and verification – Metrics : Product, process, project, testing and quality metrics – Software Test Automation

UNIT V SOFTWARE PROCESS IMPROVEMENT AND REENGINEERING **9**

SPI process – CMMI – SPI frameworks – SPI Trends – Emerging trends in Software Engineering – identifying soft trends – Technology directions – Tool-related trends – Software Maintenance and **Reengineering: software reengineering, reverse reengineering, restructuring, forward reengineering**.

TOTAL : 45 PERIODS

OUTCOMES

Upon completion of this course, the student should be able to

CO1: Select appropriate model for software development
CO2: Develop Analysis Models and Map the Analysis Models to Design Models.
CO3: Address the Design Issues related to Web Applications and Mobile Apps.
CO4: Apply testing techniques for object oriented software and web-based systems
CO5: Select efficient framework and apply reengineering in SDLC

REFERENCES

1. Titus Winters, Tom Manshreck, Hyrum Wright, Software Engineering at Google Released March 2020, O'Reilly Media, Inc.
2. Roger S. Pressman, “Software Engineering – A Practioner‟s Approach”, McGraw Hill, 7th edition, 2009.
3. Ian Sommerville, “Software Engineering”, Addison-Wesley 9th Edition, 2010

4. Bernd Bruegge, Allen H. Dutoit, "Object-Oriented Software Engineering", Prentice Hall, Third Edition, 2009.
5. Robert E. Filman, TzillaElrad, Siobhán Clarke, Mehmet Aksit, “ Aspect-Oriented Software Development”, Addison-Wesley Professional, 2004.
6. RenuRajni, Pradeep Oak, “Software Testing: Effective Methods, Tools and Techniques”, Tata McGraw Hill, 2004.
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8. Antoni Diller, “Z: An Introduction to Formal Methods”, Wiley, 1994.

9. James Shore, Shane Warden “The Art of Agile Development - Pragmatic guide to agile software development”, O'Reilly Media, October 2007.
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X22MCE61 – ADVANCED SOFTWARE ENGINEERING												
CO’s/PO’s	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	1	-	1
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	1	-	-	-	-	-
CO4	3	3	-	2	-	-	-	-	-	-	1	-
CO5	3	3	-	-	2	1	2	-	-	-	-	-
AVG	**3.00**	**3.00**	**-**	**2.00**	**2.00**	**1.00**	**3.00**	**-**	**-**	**1.00**	1.00	1.00

X22MCE62	SOFTWARE TEST AUTOMATION	L	T	P	C
		3	0	0	3

Course Objectives

- Understandthebasicsof testautomation
- Appreciatethedifferentaspects oftest tool evaluationandtestautomationapproachselection
- Understandtherole playedbytestplanninganddesign intestexecution
- Appreciatethe useofvarioustesting toolsfor testing variedapplications
- Understandtestautomationusingcasestudies

UNITI INTRODUCTION **9**

Fundamentals of test automation – Management issues – technical issues - Background on software testing – Automated test life cycle methodology (ATLM) – Test Maturity Model – Test Automation Development – Overcoming false expectations of automated testing – benefits – test tool proposal

UNITII TESTFRAMEWORK ANDAUTOMATION **9**

Test Tool Evaluation and selection — organisations_ system engineering environment — tools thatsupportthetestinglifecycle–testprocessanalysis–testtoolconsideration Test framework– TestLibraryManagement–selectingthetestautomationapproach-testteammanagement

UNITIII TESTPLANNINGANDDESIGN **9**

Testplanning–Testprogramscope–Testrequirementsmanagement–
TestEvents,ActivitiesandDocumentation — Test Environment — Evolving a Test plan Test analysis and design — Testrequirements analysis — Test program design — Test procedure design — Test developmentarchitecture–guidelines–automationinfrastructure–testexecutionandreview–testmetrics

UNITIV TESTINGTHEAPPLICATIONS **9**

Testing Web Applications–Functional Web testing with Twill–Selenium–Testing as imple Web Application– Testing Mobile Smart phone Applications–Runningautomatedtestscripts–Test tools For Browser based applications–Test Automation with Emulators

UNIT V CASE STUDIES **9**

Test automation and agile project management – database automation – test automation in cloud –Main frame and Frame work automation–Model based test case generation– ModelbasedtestingofAndroidapplications–exploratorytestautomation

CourseOutcomes

Uponcompletionofthiscourse,thestudentshouldbeableto

CO1: Identifythe different test tools

CO2: Useavailabletestingtools totestsomesoftware applications

CO3: Modifyexistingtestmetricsbasedonfunctionality orfeatures used

CO4: Design testcases andexecutethem

CO5: Implementtestscriptsforautomatingtestexecution

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1. C.TitusBrown,GheorgheGheorghiu,JasonHuggins,—AnIntroductiontoTestingWebApplicationswithtwillandSelenium‖, O'ReillyMedia,Inc.,2019.
2. Dorothy Graham, Mark Fewster, —Experiences of Test Automation: Case Studies of SoftwareTestAutomation‖,illustratedEdition,Addison-WesleyProfessional,2018.
3. Elfriede Dustin, Jeff Rashka, —Automated software testing: Introduction, Management andPerformance‖,PearsonEducation,2017.
4. JulianHarty,—APracticalGuidetoTestingMobileSmartphoneApplications,Vol.6ofSynthesis Lectureson MobileandPervasiveComputingSeries‖,Morgan&ClaypoolPublishers,2017.
5. KanglinLi,MengqiWu,—EffectiveSoftwareTestAutomation:DevelopinganAutomatedSoftware TestingTool‖,JohnWiley &Sons,2015.

X22MCE62 – SOFTWARE TEST AUTOMATION												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	3	-	2	2	-	-	-	-	-	-	-
CO2	-	3	-	2	2	-	-	-	-	-	-	-
CO3	-	3	3	-	2	-	3	-	-	-	-	-
CO4	-	3	3	2	2	-	3	-	-	-	-	-
CO5	-	3	3	2	1	-	3	-	-	-	-	-
AVG	**-**	**3.00**	**1.8**	**1.60**	**1.80**	**-**	**1.8**	**-**	**-**	**-**	**-**	**-**

X22MCE63	SOFTWARE SECURITY	L	T	P	C
		3	0	0	3

Course Objectives

- Understandtheconcepts of software securities and in securities
- Knowaboutvariousattacks
- Learnaboutsecuresoftwaredesign
- Understandrisk management insecuresoftwaredevelopment
- Knowtheworkingoftoolsrelatedtosoftwaresecurity

UNIT I INTRODUCTION 9

Need for software security – Memory based attacks – low level attacks against heap and stack -stack smashing – format string attacks – stale memory access attacks – ROP (Return oriented programming) – malicious computation without code injection.Defense against memory based attacks stack canaries – non-executable data - address space layout randomization (ASLR), memory- safety enforcement, control-flow Integrity (CFI) – randomization

UNIT II SECURE DESIGN 9

Isolating the effects of untrusted executable content - stack inspection – policy specification languages – vulnerability trends – buffer overflow – code injection - Generic network fault injection – local fault injection - SQL injection - Session hijacking.Secure design - threat modeling and security design principles - good and bad software design - Web security-browser security: cross-site scripting (XSS) , cross-site forgery (CSRF) – database security – file security.

UNIT III SECURITY RISK MANAGEMENT 9

Risk Management Life cycle – Risk Profiling – Risk exposure factors – Risk Evaluation and Mitigation - Risk Assessment Techniques – Threat and Vulnerability Management- Adopting an Enterprise software security Framework

UNIT IV SECURITY TESTING 9

Traditional software testing – comparison - secure software development life cycle - risk based security testing – prioritizing security testing with threat modeling – shades of analysis: white, grey and black box testing.

UNIT V ADVANCED SOFTWARE SECURITY 9

Advanced penetration testing – planning and scoping – DNS groper – DIG (Domain Information Graph) – Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for penetration testing

TOTAL : 45 PERIODS

COURSE OUTCOMES

CO1 : Identify commonsecurity threats, risks, and attack vectors for software systems
CO2 : Evaluate security best Practices and defense mechanisms for current software systems.
CO3: Understand security protocols and verification issues
CO4 : Involveselectionoftestingtechniquesrelatedtosoftwaresecurityintestingphaseofsoftware development
CO5 : Understand and model the economics of software security

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2. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, —The Art of Software SecurityTesting: Identifying Software Security Flaws (Symantec Press)‖, Addison-Wesley Professional,2018
3. Evan Wheeler, —Security Risk Management: Building an Information Security Risk ManagementProgramfromthe GroundUp‖,Firstedition,SyngressPublishing,2021
4. LeeAllen,—AdvancedPenetrationTestingforHighly-SecuredEnvironments:TheUltimateSecurityGuide (OpenSource:CommunityExperienceDistilled)‖,KindleEdition,PacktPublishing,2019
5. Mike Shema, —Hacking Web Apps: Detecting and Preventing Web Application Security Problems‖,Firstedition,Syngress Publishing,2019

X22MCE63 – SOFTWARE SECURITY												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	3	-	2	2	-	-	-	-	-	-	-
CO2	-	3	-	2	2	-	-	-	-	-	-	-
CO3	-	3	3	-	2	-	-	-	-	-	-	-
CO4	-	3	3	2	2	-	-	-	-	-	-	-
CO5	-	3	2	2	1	-	-	-	-	-	-	-
AVG	**-**	**3.00**	**1.60**	**1.60**	**1.80**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

X22MCE64	INTEGRATED SOFTWARE PROJECTMANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITES : SoftwareEngineering

CourseObjectives

- Understandthebasicconceptofprojectmanagement,projectplanningandEvaluation.
- Learnthevariouscostingandlifecyclemanagement.
- Understandtheroleplayedbyriskinsoftwareproject.
- Appreciatetheuseofmetricsforsoftwareprojectmanagement.
- Knowthechallengesinpeoplemanagement.

UNITI PROJECT EVALUATIONANDPROJECTPLANNING 9

Importance of Software Project Management – Activities Methodologies – Categorization of SoftwareProjects – Setting objectives – Management Principles – Management Control – Project portfolio Management–Cost-benefit evaluation technology –Riske valuation–Strategic program Management Step wise Project Planning – **Feasibility study: Types of Feasibility steps in Feasibility study** .

UNITII PROJECT MANAGEMENT&COSTING 9

Software Project Management approaches– **Project Management Lifecycle**– Project Acquisition– Initiation– Planning–PERTExecutionandControl–CPM–ChangeManagement–ProjectClosure–Agile SPM Problems in Software Estimation– Algorithmic Cost Estimation Process, Function Points, COCOMO II Constructive Cost Model)–Estimating Web Application Development–Concepts of Finance, Activity Based Costing and Economic Value Added(EVA)–Balanced Scorecard.

UNITIII ACTIVITY PLANNING AND RISK MANAGEMENT 9

ObjectivesofActivityplanning–Projectschedules–Activities–Sequencingandscheduling–NetworkPlanning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Criticalpath (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management - RiskRetention - Risk Transfer - Failure Mode and Effects Analysis (FMEA) - Operational Risks – SupplyChainRiskManagement.

UNIT IV METRICS 9

Need for Software Metrics – scope – basics – framework for software measurement - Classification ofSoftware Metrics: Product Metrics (Size Metrics, Complexity Metrics, Halstead's Product Metrics,Quality Metrics), and Process metrics (Empirical Models, Statistical Models, Theory-based Models,CompositeModels,andReliabilityModels)–measuringinternalandexternalproduct.

UNITV PEOPLE MANAGEMENT **9**

Leadership styles – Developing Leadership skills – Leadership assessment – Motivating People – Organizational strategy – Management – Team building – Delegation – Art of Interviewing People - TeamManagement– Rewarding-ClientRelationshipManagement.

Total:45periods

CourseOutcomes

Uponcompletionofthecourse, thestudentswillbeableto:

CO1: Identifythevariouselementsofsoftwaremanagementprocessframework.

CO2: Useavailableopensourceestimationtoolsforcostestimation.

CO3: Identifyexistingriskandperformriskassessment.

CO4: Designasoftwaremetricforsoftwareprojectmanagementandpeoplemanagement.

CO5: Learn staff selection process and the issues related to people management.

REFERENCES :

1. Antonio Borghesi, Barbara Gaudenzi, —Risk Management: How to Assess, Transfer andCommunicateCriticalRisks:PerspectivesinBusinessCulture,IllustratedEdition,Springer,2019.
2. MuraliChemuturi,ThomasM.Cagley,—Mastering SoftwareProjectManagement:BestPractices,ToolsandTechniques,J.RossPublishing,2016.
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4. Stark,John,—DecisionEngineering:ProductLifecycleManagement: 21stCenturyParadigmforProductRealization,2ndEdition,SpringerLondon,2011.
5. BobHughes,MikeCotterellandRajibMall:SoftwareProjectManagement– EighthEdition,TataMcGrawHill,NewDelhi,2018.
6. Gopalaswamy Ramesh, —Managing Global Software Projects‖ – McGraw Hill Education(India), FourteenthReprint2015.

X22MCE64 – INTEGRATED SOFTWARE PROJECTMANAGEMENT												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	2	1	1	2	-	-	-	-	-	-	-
CO2	1	3	1	-	-	1	-	-	-	-	-	-
CO3	2	2	3	2	2	-	-	-	-	-	-	-
CO4	1	2	2	3	2	2	-	-	-	-	-	-
CO5	3	1	1	1	-	3	-	-	-	-	-	-
AVG	**1.16**	**1.66**	**1.50**	**1.16**	**1.00**	**1.00**	**-**	**-**	**-**	**-**	-	-

		L	T	P	C
X22MCE65	**SOFTWARE RELIABILITY METRICES AND MODELLING**	**3**	**0**	**0**	**3**

Course Objectives

- Learndifferent definitionsof softwarequality
- Knowdifferentnotionsofdefectsandclassify them
- Understandthebasic techniquesofdatacollection andhow toapply them
- Learn softwaremetricsthatdefinerelevantmetricsinarigorousway.
- Gainconfidenceinultra-highreliability.

UNITI INTRODUCTION TO SOFTWARE RELIABILITY 9

Defining failure – choosing a common measure – System and software failure intensity objectives – software reliability strategies - Failures, Faults and Errors – Availability – system and component reliabilities – basic failure intensity - Need for reliable software – concepts - The Dependability Concept - Failure Behavior of an X- ware System.

UNITII SOFTWARE RELIABILITY MODELING 9

Concepts — General Model Characteristic — Historical Development of models — Model Classification scheme–Monrovian models–General concepts–General Poisson Type Models– Binomial Type Models–Poisson Type models–Fault reduction factor for Poisson Type models.

UNITIII SOFTWARE RELIABILITY GROWTH MODELS 9

Comparison Criteria — Failure Data — Comparison of Predictive Validity of Model Groups — Recommended Models – Comparison of Time Domains – Calendar Time Modeling – LimitingResource Concept – Resource Usage model – Resource Utilization – Calendar Time EstimationandconfidenceIntervals .

UNITIV FUNDAMENTALS OF MEASUREMENT 9

Measurements in Software Engineering–Scope of Software metrics–Measurements theory–Goal based Frame work–Software Measurement Validation.

UNITV SOFTWARE PROCESS IMPROVEMENT AND REENGINEERING 9

Measurement of Internet Product Attributes–Size and Structure–External Product Attributes – Measurement of Quality–Software Reliability: Measurement and Prediction.

Total: 45periods

CourseOutcomes

Upon completion of this course, the student should be able to

CO1: Identify appropriate failure models based on the testing Metrices

CO2: Performsomesimplestatisticalanalysis relevant tosoftware measurementdata.

CO3: Discussmethodsandtechniquesforsoftware reliability models

CO4: Applyfrom practical examples for both the benefits and limitations of software metrics for quality control and assurance

CO5: Understand the importance of Software maintenance and its improvements

X22MCE65 – SOFTWAR RELIABILITY METRICES AND MODELLING												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	2	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-
CO3	3	-	-	2	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-
AVG	**3.00**	**-**	**2.00**	**2.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

X22MCE66	SOFTWARE VERIFICATION AND VALIDATION	L	T	P	C
		3	0	0	3

Course Objectives

- Understandtheprinciples ofverificationandvalidation
- Appreciatethedifferentverificationandvalidation techniques
- Understandthevarious stagesof testing
- Appreciatetheuse of toolsforverification andvalidation
- Appreciatethe benefitsof using metricsforverificationandvalidation

UNITI INTRODUCTION **9**

Principles of Verification and Validation–Software Architecture Frameworks–Model Driven Architecture–UML–Systems Modeling Language–Verification, Validation and Accreditation.

UNITII METHODS OF SOFTWARE VERIFICATION **9**

Verification and Validation life cycle – Traceability analysis – Interface Analysis – Design and Code Verification—Test Analysis-Reviews—Inspections-Walk throughs—Audits—Tracing—Formal Proofs—Model based Verification and Validation - Program Verification Techniques – Formal Methods of SoftwareVerification—CleanRoomMethods.

UNITIII TESTING **11**

Stages of Testing: Test Planning – Test Design – Test Case Definition – Test Procedure – Test Reporting –Unit Testing: White box , Black box and Performance Testing – System Testing: Function, Performance,Interface, Operations, Resource, Security, Portability, Reliability, Maintainability, Safety, Regression and Stresstesting–Integrationtesting– Acceptancetesting:Capability,Constrainttesting-Structuredtesting– Structuredintegrationtesting - **Case Study: FitNesse ,MozillaTestopia , Bromine ,TestCaseWeb(TCW)**

UNITIVTOOLSFOR SOFTWAREVERIFICATION **9**

Tools for Verification and Validation: Static analyzer – Configuration Management Tools – ReverseEngineering Tools – Tracing Tools – Tools for Formal Analysis – Tools for testing – Test Case Generators –Test Harnesses–Debuggers–Coverage Analysers–Performance Analysers– TestManagementTools - **Case Study : Selenium , Appium.**

UNITV ADVANCED APPROACHES **7**

Automatic Approach for Verification and Validation–Validating UML behavioral diagrams–Probabilistic model checking of Activity Diagrams in SysML–Metrics for Verification and Validation.

Total: 45Periods

CourseOutcomes

Upon completion of this course, the student should be able to

CO1: Identify the differenttechniquesforverificationandvalidation

CO2: Useavailabletraceabilityanalysistoolsonsamplerequirements

CO3: Modifyexistingcoverageanalyzersintermsoffunctionalityorfeatures used

CO4: Design system testcases

CO5: Use testcase generators and testmanagementtools

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1. MarcusS.Fisher,—SoftwareVerificationandValidation:AnEngineeringandScientificApproach ,Springer,2012
2. MouradDebbabi,HassaineF,JarryaY.,SoeanuA.,AlawnehL.,—Verification and Validation in Systems Engineering ,Springer,2010
3. AvnerEngel,—Verification,Validation&TestingofEngineeredSystems‖,WileyseriesinsystemsEngineeringandManagement,2015.
4. ESA Board for Software Standardization and Control (BSSC),—Guide to software verification and Validation ,European Space Agency ESAPSS-05-10 Issue1Revision1,2001.

X22MCE66 – SOFTWARE VERIFICATION AND VALIDATION												
CO's/PO's	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	2	-	-	-	-	-	-	-	-
CO2	-	2	2	-	-	-	-	-	-	-	-	-
CO3	2	-	-	2	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-
AVG	**3.00**	**2.00**	**2.00**	**2.00**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**