ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

MASTER OF COMPUTER APPLICATIONS (2 YEARS)

DEPARTMENT OF INFORMATION SCIENCE AND TECHNOLOGY

Vision of the Department

To educate students with conceptual knowledge and technical skills in the field of Information Technology with moral and ethical values to achieve excellence in academic, industry and research centric environments.

Mission of the Department

1. To inculcate in students a firm foundation in theory and practice of IT skills coupled with the thought process for disruptive innovation and research methodologies, to keep pace with emerging technologies.
2. To provide a conducive environment for all academic, administrative and interdisciplinary research activities using state-of-the-art technologies.
3. To stimulate the growth of graduates and doctorates, who will enter the workforce as productive IT engineers, researchers and entrepreneurs with necessary soft skills, and continue higher professional education with competence in the global market.
4. To enable seamless collaboration with the IT industry and Government for consultancy and sponsored research.
5. To cater to cross-cultural, multinational and demographic diversity of students.
6. To educate the students on the social, ethical, and moral values needed to make significant contributions to society.

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MASTER OF COMPUTER APPLICATIONS

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO#	Programme Educational Objectives
1	To prepare students with breadth of knowledge to comprehend, analyze, design and create computing solutions to real-life problems and to excel in industry/ technical profession.
2	To provide students with solid foundation in mathematical and computing fundamentals and techniques required to solve technology related problems and to pursue higher studies and research.
3	To inculcate a professional and ethical attitude in students, to enable them to work towards a broad social context.
4	To empower students with skills required to work as member and leader in multidisciplinary teams and with continuous learning ability on technology and trends needed for a successful career.

2. PROGRAMME OUTCOMES (POs):

After going through the two years of study, our master's in computer applications Graduates will exhibit ability to:

PO#	Programme Outcome
1.	**Computational Knowledge:** Apply knowledge of computing fundamentals, computing specialisation, mathematics, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models from defined problems and requirements.
2.	**Problem Analysis:** Identify, formulate, research literature and solve *complex* computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
3.	**Design /Development of Solutions:** Design and evaluate solutions for *complex* computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4.	**Conduct investigations of complex Computing problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5.	**Modern Tool Usage:** Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to *complex* computing activities, with an understanding of the limitations.

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6.	**Professional Ethics:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
7.	**Life-long Learning:** Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.
8.	**Project management and finance:** Demonstrate knowledge and understanding of t h e c o m p u t i n g and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
9.	**Communication Efficacy:** Communicate effectively with the computing community, and with society at large, about *complex* computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
10.	**Societal and Environmental Concern:** Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.
11.	**Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
12.	**Innovation and Entrepreneurship:** Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

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3. PEO/PO Mapping:

Programme Educational Objectives	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
II	✓	✓	✓	✓	✓		✓		✓		✓	
III	✓					✓				✓	✓	
IV	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

Mapping of Course Outcome and Programme Outcome

Year		COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
YEAR 1	SEM 1	Linear Algebra, Probability and Statistics	✓	✓					✓				✓	
		Data Structures & Algorithms	✓	✓	✓		✓		✓				✓	
		Python Programming	✓	✓	✓		✓		✓				✓	
		Network Programming and Device Management	✓	✓	✓		✓		✓				✓	
		Content Technologies	✓	✓	✓		✓		✓				✓	✓
		Research Methodology and IPR	✓	✓				✓	✓	✓	✓	✓	✓	✓
		Audit Course I											✓	
		Programming in Python Laboratory	✓	✓	✓		✓	✓	✓		✓		✓	
		Data structures & Algorithms Laboratory	✓	✓	✓		✓	✓	✓		✓		✓	
	SEM 2	Cloud Computing Techniques	✓	✓	✓	✓	✓		✓				✓	✓
		Data Analytics	✓	✓	✓	✓	✓		✓	✓			✓	✓
		Advanced Java Programming	✓	✓	✓		✓		✓				✓	
		Full Stack Software Development	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
		Full Stack Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective I												
		Professional Elective II												
		Audit Course II												
		Mobile Application Development Laboratory	✓	✓	✓		✓	✓	✓		✓		✓	✓

Year		COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
YEAR 2	SEM 3	Artificial Intelligence & Machine Learning	✓	✓	✓	✓	✓			✓		✓	✓	✓
		Internet of Things	✓	✓	✓	✓	✓						✓	✓
		Cyber Security	✓	✓	✓	✓	✓	✓				✓	✓	
		Professional Elective III												
		Professional Elective IV												
		Professional Elective V												
		Open Elective												
		Machine Learning Techniques Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
	SEM 4	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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CURRICULUM AND SYLLABUS FOR I – IV SEMESTER

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5104	Linear Algebra, Probability and Statistics	FC	3	1	0	4	4
2.	CA5104	Data Structures & Algorithms	PCC	3	0	0	3	3
3.	CA5105	Python Programming	PCC	3	0	0	3	3
4.	CA5106	Content Technologies	PCC	3	0	2	5	4
5.	CA5107	Network Programming and Device Management	PCC	3	0	0	3	3
6.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
7.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
8.	CA5111	Programming in Python Laboratory	PCC	0	0	4	4	2
9.	CA5113	Data Structures & Algorithms Laboratory	PCC	0	0	4	4	2
			TOTAL	**19**	**1**	**10**	**30**	**23**

*Audit course is optional

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CA5206	Data Analytics	PCC	3	0	2	5	4
2.	CA5207	Advanced Java Programming	PCC	3	0	2	5	4
3.	CA5208	Full Stack Software Development	PCC	3	0	0	3	3
4.	CA5209	Cloud Computing Techniques	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
8.	CA5213	Full Stack Laboratory	EEC	0	0	4	4	2
9.	CA5511	Mobile Application Development Laboratory	EEC	0	0	4	4	2
			TOTAL	**20**	**0**	**12**	**32**	**24**

*Audit course is optional

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SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CA5304	Artificial Intelligence & Machine Learning	PCC	3	0	0	3	3
2.	CA5305	Internet of Things	PCC	3	0	2	5	4
3.	CA5306	Cyber Security	PCC	3	0	2	5	4
4.		Professional Elective III	PEC	3	0	0	3	3
5.		Professional Elective IV	PEC	3	0	0	3	3
6.		Professional Elective V	PEC	3	0	0	3	3
7.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
8.	CA5314	Machine Learning Techniques Laboratory	EEC	0	0	4	4	2
			TOTAL	**21**	**0**	**8**	**29**	**25**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	CATEG-ORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	CA 5414	Project Work	EEC	0	0	24	24	12
			TOTAL	**3**	**0**	**24**	**27**	**12**

TOTAL CREDITS: 84

LIST OF FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	MA5104	Linear Algebra, Probability and Statistics	3	1	0	4	4
		TOTAL	**3**	**1**	**0**	**4**	**4**

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LIST OF PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CA5104	Data Structures & Algorithms	3	0	0	3	3
2.	CA5105	Python Programming	3	0	0	3	3
3.	CA5107	Network Programming and Device Management	3	0	0	3	3
4.	CA5106	Content Technologies	3	0	2	5	4
5.	CA5111	Programming in Python Laboratory	0	0	4	4	2
6.	CA5113	Data structures & Algorithms Laboratory	0	0	4	4	2
7.	CA5209	Cloud Computing Techniques	3	0	0	3	3
8.	CA5206	Data Analytics	3	0	2	5	4
9.	CA5207	Advanced Java Programming	3	0	2	5	4
10.	CA5208	Full Stack Software Development	3	0	0	3	3
11.	CA5304	Artificial Intelligence & Machine Learning	3	0	0	3	3
12.	CA5305	Internet of Things	3	0	2	5	4
13.	CA5306	Cyber Security	3	0	2	5	4
		TOTAL	**33**	**0**	**18**	**51**	**42**

LIST OF PROFESSIONAL ELECTIVES (PEC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CA5001	Blockchain Technologies	3	0	0	3	3
2.	CA5002	Ethical Hacking	3	0	0	3	3
3.	CA5003	Big Data with R	3	0	0	3	3
4.	CA5007	E-Learning Techniques	3	0	0	3	3
5.	CA5008	Software Testing	3	0	0	3	3
6.	CA5009	Deep Learning Techniques and Applications	3	0	0	3	3
7.	CA5010	Game Programming Techniques	3	0	0	3	3
8.	CA5011	Multimedia Technologies	3	0	0	3	3
9.	CA5012	Data Visualization Techniques	3	0	0	3	3
10.	CA5014	C# and .NET Programming	3	0	0	3	3
11.	CA5015	Service Oriented Architectures	3	0	0	3	3
12.	CA5016	Software Project Management	3	0	0	3	3
13.	CA5017	Mixed Reality	3	0	0	3	3
14.	CA5018	Digital Image Processing and Applications	3	0	0	3	3

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
15.	CA5019	Text Mining Techniques	3	0	0	3	3
16.	CA5020	Data Warehousing and Data Mining Techniques	3	0	0	3	3
17.	CA5021	Software Quality Assurance	3	0	0	3	3
18.	CA5022	Introduction to Social Network Analysis	3	0	0	3	3
19.	CA5028	Wireless Sensor Networks & Protocols	3	0	0	3	3
20.	CA5032	Semantic Web and Applications	3	0	0	3	3
21.	CA5033	Soft Computing	3	0	0	3	3
22.	CA5034	Cognitive Computing	3	0	0	3	3
23.	CA5035	Middleware Technologies	3	0	0	3	3
24.	CA5036	UI & UX	3	0	0	3	3
25.	CA5037	Robotic Process Automation	3	0	0	3	3
26.	CA5038	Software Design Principles & Architecture Patterns	3	0	0	3	3
27.	CA5039	Autonomous Ground Vehicle and Unmanned Aerial Vehicle Systems	3	0	0	3	3
28.	CA5040	Financial Technologies	3	0	0	3	3
29.	CA5041	Linux Administration	3	0	0	3	3
30.	CA5042	Voice Technology	3	0	0	3	3
31.	CA5043	Business Domains and Verticals	3	0	0	3	3
32.	CA5044	Digital Forensics	3	0	0	3	3
TOTAL			**96**	**0**	**0**	**96**	**96**

LIST OF RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	RM5151	Research Methodology and IPR	2	0	0	2	2
TOTAL			**2**	**0**	**0**	**2**	**2**

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LIST OF OPEN ELECTIVE COURSES (OEC)

*(out of 6 courses one course must be selected)

S.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	OE5091	Business Data Analytics	3	0	0	3	3
2.	OE5092	Industrial Safety	3	0	0	3	3
3.	OE5093	Operations Research	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	3	0	0	3	3
5.	OE5095	Composite Materials	3	0	0	3	3
6.	OE5096	Waste to Energy	3	0	0	3	3
		TOTAL	**18**	**0**	**0**	**18**	**18**

LIST OF AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	AX5091	English for Research Paper Writing	2	0	0	2	0
2.	AX5092	Disaster Management	2	0	0	2	0
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	2	0
4.	AX5094	Value Education	2	0	0	2	0
5.	AX5095	Constitution of India	2	0	0	2	0
6.	AX5096	Pedagogy Studies	2	0	0	2	0
7.	AX5097	Stress Management by Yoga	2	0	0	2	0
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	2	0
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	2	0
		TOTAL	**18**	**0**	**0**	**18**	**0**

LIST OF EMPLOYABLITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	CA5213	Full Stack Laboratory	0	0	4	4	2
2.	CA5511	Mobile Application Development Laboratory	0	0	4	4	2
3.	CA5314	Machine Learning Techniques Laboratory	0	0	4	4	2
4.	CA5414	Project Work	0	0	24	24	12
		TOTAL	**0**	**0**	**36**	**36**	**18**

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LIST OF BRIDGE COURSES (BC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
Semester I							
1.	MA5105	Mathematical Foundations of Computer Science	3	0	0	3	3
2.	BX5001	Fundamentals of Computing	3	0	0	3	3
3.	BX5004	Basic Data Structures	3	0	0	3	3
4.	BX5006	Software Engineering	3	0	0	3	3
5.	BX5008	C Programming and Data Structures Laboratory	0	0	4	4	2
Semester II							
6.	BX5002	Digital Logic & Computer Organization	3	0	0	3	3
7.	BX5003	Operating systems	3	0	0	3	3
8.	BX5005	Database Management Systems	3	0	0	3	3
9.	BX5007	Java programming	3	0	0	3	3
10.	BX5009	Database Management Systems Laboratory	0	0	4	4	2
11.	BX5010	Java Programming Laboratory	0	0	4	4	2
		TOTAL	**24**	**0**	**12**	**36**	**30**

SEMESTER-WISE CREDIT DISTRIBUTION

S. NO	CATEGORY	CREDITS PER SEMESTER				CREDITS
		I	II	III	IV	
1.	Foundation Courses (FC)	4	0	0	0	4
2.	Professional Core Courses (PCC)	17	14	11	0	42
3.	Professional Elective Courses (PEC)	0	6	9	0	15
4.	Open Elective Courses (OEC)	0	0	3	0	3
5.	Research Methodology and IPR Courses (RMC)	2	0	0	0	2
6.	Employability Enhancement Courses (EEC)	0	4	2	12	18
7.	Audit Courses (AC)	0	0	0	0	0
	TOTAL	**23**	**24**	**25**	**12**	**84**

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MA5104	LINEAR ALGEBRA, PROBABILITY AND STATISTICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To find the basis and dimension of vector space
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors
- To provide foundation on Applied Probability
- To use various statistical techniques in Application problems
- To introduce the concept of Design of Experiments for data analysis.

UNIT I VECTOR SPACES 12

Real and Complex fields - Vector spaces over Real and Complex fields - Sub space - Linear space - Linear independence and dependence - Basis and dimension.

UNIT II LINEAR TRANSFORMATION 12

Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and Eigenvectors of linear transformation.

UNIT III PROBABILITY AND RANDOM VARIABLES 12

Probability - Axioms of Probability - Conditional Probability - Addition and multiplication laws of Probability - Baye's theorem - Random Variables - Discrete and continuous random variables - Probability mass function and Probability density functions - Cumulative distribution function - Moments and variance of random variables - Properties - Binomial, Poisson, Geometric, Uniform, Exponential, Normal distributions and their properties.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions - Tests based on small and large samples - Normal, Student's t, Chi-square and F distributions for testing of mean, variance and proportion and testing of difference of means variances and proportions - Tests for independence of attributes and goodness of fit.

UNIT V DESIGN OF EXPERIMENTS 12

Analysis of variance - Completely randomized design - Random block design (One-way and Two-way classifications) - Latin square design -2^2 Factorial design.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Test the consistency and solve system of linear equations.
2. Find the basis and dimension of vector space.
3. Apply the Probability axioms as well as rules and the distribution of discrete and continuous also the random variable ideas in solving real world problems.
4. Use statistical techniques in testing hypothesis on data analysis.
5. Use the appropriate statistical technique of design of experiments in data analysis.

REFERENCES:

1. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Prentice Hall of India, New Delhi, 2004.
2. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications),

New Delhi, 2002.
3. Devore, J.L, Probability and Statistics for Engineering and Sciences, Cengage Learning, Eighth Edition, New Delhi, 2014.
4. I. Miller and M. Miller, Mathematical Statistics, Pearson Education Inc., Asia Seventh Edition, New Delhi, 2011.
5. Richard Johnson, Miller and Freund's Probability and Statistics for Engineer, Prentice Hall of India Private Ltd., Eighth Edition, New Delhi, 2011.

CA5104	DATA STRUCTURES & ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts of linear data structures and its applications.
- To understand the concepts of non-linear data structures like trees and graphs.
- To learn the usage of sorting techniques.
- To familiarize the concepts of hashing.
- To understand about algorithm analysis and design techniques.

UNIT I LINEAR DATA STRUCTURES 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List Implementation – Doubly-Linked Lists – Circular Linked Lists – Stack ADT: Implementation of Stacks – Queue ADT: Implementation of Queues – Applications.

Suggested Activities:

- Flipped classroom on basics of ADT's.
- External learning - Cursor based implementation of linked lists, applications of lists, double ended queue.
- Practical - Implementation of Tower of Hanoi using Recursion.
- Practical - Implementation of Polynomial ADT using Lists.
- Practical - Implementation of the Evaluation of expression using Stack ADT.
- Practical - Implementation of any one application of Queue.

Suggested Evaluation Methods:

- Quizzes on ADTs.
- Assignments on double ended queues, applications of lists.
- Demonstration of the practical implementations.

UNIT II ALGORITHMS IN COMPUTING 9

Introductions to Algorithms – Iterative and Recursive Algorithms – Designing Algorithms – Analyzing Algorithms – Growth of Functions: Asymptotic Notations – Standard Notations and Common Functions – Recurrences: The Substitution Method – The Recursion – Tree Method – Master's Method.

Suggested Activities:

- Flipped classroom on basics of algorithms and design of algorithms.
- Assignment on finding order of growth for exponent and logarithmic time algorithms.
- Assignment on analysis of time complexity for different algorithms such as sorting, searching and series generation.
- Assignment on solving recurrence relations using substitution and recursion tree method.
- Assignment on formulation of recurrence equations for recursive programs such as Tower of Hanoi, staircase, and triangular number problems.

Suggested Evaluation Methods:

- Assignments on problem solving exercises.
- Evaluation of order of growth for various algorithms.

- Evaluation of the assignments.
- Evaluation of recurrence relations solutions.

UNIT III HIERARCHICAL DATA STRUCTURES & HASHING 9

Trees: Preliminaries – Implementation of Trees – Tree Traversals with an Application – Binary Trees: Implementation – Expression Trees – Search Tree ADT – Binary Search Trees – Applications of Trees - Fundamentals of Hashing – Hash Function – Separate Chaining – Open Addressing – Linear Probing – Quadratic Probing – Double Hashing

Suggested Activities:

- Flipped classroom on fundamentals of non-linear data structures.
- External learning - Operations on binary search tree, complete binary tree.
- Practical - Implementation of operations such as counting the number of nodes in a BST, finding predecessor and successor of a given node, second largest node in a BST, finding the mirror image of a given tree etc.
- Flipped classroom on binary heap operations.
- External learning on D-heaps.
- Practical - Implementation on min max heaps.

Suggested Evaluation Methods:

- Quizzes on fundamentals of non-linear data structures.
- Assignments on complete binary tree.
- Demonstration for practical implementations.

UNIT IV SORTING, TREES AND GRAPHS 12

Sorting Algorithms: Insertion Sort, Quick Sort, Heap Sort - AVL Trees – B-Trees - Binary Heaps – Min Max Heaps - Graphs: Representation of Graphs – Graph Traversals – Topological Sort – Shortest Path Algorithms: Dijkstra's Algorithm – Minimum Spanning Tree: Prim's and Kruskal's Algorithm.

Suggested Activities:

- Flipped classroom different sorting techniques such as Bubble Sort, Selection Sort etc.
- External learning - Search algorithms, priority queues, external sorting, replacement selection technique.
- Practical - Solving a search problem in O(1) time using hashing technique.
- Assignment on choosing and applying an efficient sorting technique for a given problem.
- Practical - Solving a given problem using efficient search technique.
- Flipped classroom on basics of graphs and graph operations.
- External learning on applications of graphs and DFS.
- Practical Learning to choose and apply a suitable graph algorithm for solving a real time problem/scenario such as finding shorter routes in networks, finding relationship in social network graphs.

Suggested Evaluation Methods:

- Quizzes on basics of hashing and sorting.
- Assignments on creation and manipulation of hash table, priority queues.
- Demonstration of the practical implementations.
- Assignments on problem solving on 2-3 trees and M-ary trees.
- Quizzes on binary trees and tree traversals.
- Assignments on applications of graphs and DFS.
- Quizzes on graph operations.

UNIT V ALGORITHM DESIGN TECHNIQUES 9

Greedy Algorithms: Huffman Codes – Divide and Conquer: Merge Sort – Dynamic Programming: Using a Table instead of Recursion – Ordering Matrix Multiplications – Introduction to NP Completeness.

Suggested Activities:

- Flipped classroom on basics of algorithm design strategies.
- External learning -Backtracking algorithms, e.g., n queens' problem.
- Practical - Choose and apply a suitable algorithm design technique for solving real time problems such as puzzle solving, checkerboard and job selection.

Suggested Evaluation Methods:

- Assignments on backtracking techniques.
- Quizzes on algorithm design strategies.
- Demonstration of practical learning.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Use abstract data types including stacks, queues and lists for any application.
2. Design and implement tree data structures.
3. Analyze and implement hashing techniques that solve in linear time.
4. Apply sorting algorithms for a given problem.
5. Design algorithms using graph structures to solve real life problems.
6. Choose appropriate data structure and implement a given application.

REFERENCES:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2. V. Alfred, J. E. Hopcroft, J. D. Ullman, "Data Structures and Algorithms", Pearson education Asia, 1983.
3. Robert Kruse & Bruce Leung, "Data Structures & Program Design in C", Pearson Education, 2007.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning, 2002.
5. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2014.
6. Anany Levitin, "Introduction to Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

CA5105	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the basics of Python programming.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures – lists, tuples, dictionaries.
- To work with input/output files, and scripts.

UNIT I VARIABLES, OPERATORS AND CONDITIONALS 9

Introduction to Python Programming – Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements- Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs

Suggested Activities:

- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.
- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.

Suggested Evaluation Methods:

- Tutorials on Python programs.

UNIT II LOOPS AND FUNCTIONS 9

Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

Suggested Activities:

- Practical - Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods:

- Tutorials for the above activities.
- Group discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Suggested Activities:

- Practical - Implementing Python program using lists, tuples, sets for the following scenario:
  - Simple Sorting techniques
  - Student Examination Report
  - Billing Scheme during Shopping
- External learning - List versus Tuple versus Set
- Practical - Implementing any application using the three data structures, list, tuple and set.

Suggested Evaluation Methods:

- Tutorials for the above activities.
- Group discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES 9

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built – In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built – in Dictionary Function – Finding Key And Value in a Dictionary – Modules: Introduction – Module Loading and Execution – Packages – Making Your Own Module – The Python Standard Libraries.

Suggested Activities:

- Practical - Implementing Python program by importing Time module, Math package, etc.
- Creation of your own package and importing into the application.

Suggested Evaluation Methods:

- Tutorials for the above activities.

UNIT V FILE HANDLING, EXCEPTION HANDLING AND SYSTEM LEVEL COMMANDS 8

Files: Introduction – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions - Scripts: modules to access OS internals - examples - os- pid - psutil - .shutil - glob – sys.

Suggested Activities:

- Develop modules using Python to handle files and all operations on files.
- Usage of exceptions, multiple except blocks for applications that use delimiters like age, range of numerals, etc.
- Practical - Implementing Python program to open non-existent file using exceptions.

Suggested Evaluation Methods:

- Tutorials for the above activities.
- Automate system tasks using scripts
- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs
3. Structure simple Python programs and functions for solving problems.
4. Represent compound data using Python lists, tuples, dictionaries.
5. Read and write data from/to files in Python programs.
6. Automate operating system level tasks using Scripts

REFERENCES:

1. Reema Thareja, “Python Programming using Problem Solving Approach”, Oxford University Press, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, Shroff/O‘Reilly Publishers, 2016. (http://greenteapress.com/wp/thinkpython/).
3. Guido van Rossum, Fred L. Drake Jr., “An Introduction to Python – Revised and Updated for Python 3.2”, Network Theory Ltd., 2011.
4. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and Expanded Edition, MIT Press, 2013
5. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley India Edition, 2016.
6. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
7. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, Cengage Learning, 2012.
8. Martelli, A., Ravenscroft, A. M., and Ascher, D., editors (2005). Python Cookbook. O’Reilly, Sebastopol, California, Second Edition.
9. https://www.python-course.eu/os_module_shell.php

CA5106 CONTENT TECHNOLOGIES

L	T	P	C
3	0	2	4

OBJECTIVES:

- To learn the fundamentals of document databases technologies
- To study the working principles of graph and column databases.
- To have an introductory knowledge about the distributed database patterns.
- To understand the basics of digital asset management and its importance.
- To learn DAM metrics and strategies.

UNIT I DOCUMENT DATABASES 9

XML and XML Databases - XML Tools and Standards - XPath - XQuery - XML Schema - XSLT - DOM - XML Databases - JSON Document Databases - JSON and AJAX - JSON Databases - Data Models in Document Databases - MongoDB - Data manipulation using MongoDB.

Suggested Activities:

1. Creation of XML Schema using software tools and validating XML documents
2. Creation of JSON documents and realizing and using with AJAX

3. Database manipulation using MongoDB (Creation / Insertion / Updation / Deletion)

Suggested Evaluation Methods:

- Program based evaluation
- Assignments using appropriate technology / tool
- Simple projects using these technologies

UNIT II GRAPH AND COLUMN DATABASES 9

RDBMS Patterns for Graphs - RDF and SPARQL - Property Graphs and Neo4j - Graph Database Internals - Column Databases - Data Warehousing Schemas - Limitations - The Columnar Alternative- Columnar Compression - Columnar Write Penalty - Column Database Architectures - Projections - Columnar Technology in Other Databases - SSD and In-Memory Databases - Solid State Disk - SSD-Enabled Databases - In-Memory Databases - Redis - Oracle 12c “in-Memory Database” - Spark Architecture.

Suggested Activities:

4. Creation of RDF and OWL based semantics documents
5. Creation of column databases with various technologies
6. Exploring In-memory Databases supported in various technologies

Suggested Evaluation Methods:

- Program based evaluation
- Assignments using appropriate technology / tool
- Simple projects using these technologies

UNIT III DISTRIBUTED DATABASE PATTERNS 9

Distributed Relational Databases - Replication - Nonrelational Distributed Databases - MongoDB Sharding and Replication - Sharding Mechanisms - Cluster Balancing - Replication - HBase - Tables, Regions, and Region Servers - Caching and Data Locality - Cassandra - Consistency Models - ACID and MVCC - Consistency in MongoDB.

Suggested Activities:

- Creation of nonrelational distributed databases
- Practical solutions based on HBase
- Exploring consistency models in MongoDB

Suggested Evaluation Methods:

- Program based evaluation
- Assignments using appropriate technology / tool
- Simple projects using these technologies

UNIT IV DIGITAL ASSETS MANAGEMENT 9

Introduction to DAM - Need for DAM - Types of DAMs - DAM server environment - Assets to Manage - Asset types - Static Versus Living Assets - Versioning - Creating and Accessing Assets - Arranging and Describing Assets - User System Requirements: XMP and XML - Finding Assets - Basic Metadata and Search Strategies.

Suggested Activities:

- Realizing DAM server environment
- Creation and accessing assets
- Search strategies for asset management

Suggested Evaluation Methods:

- Program based evaluation

- Assignments using appropriate technology / tool
- Simple projects using these technologies

UNIT V DAM METRICS AND STRATEGIES 9

Describing and Searching Mass Sets - Content Audit and Determining Metrics - Building Successful DAM workflow - Digital Preservation and Content Migration Strategies - Brand and Rights Management -DIGITAL ASSET API - Digital Asset Metadata API.

Suggested Activities:

- Building DAM workflow
- Creation and Digital Asset API
- Brand and Rights Management

Suggested Evaluation Methods:

- Assignments
- Comparison of DAM strategies
- Group discussion

EXERCISES: 30

1. Using XML and allied technologies create a database.
2. Using schema validate the XML document.
3. Creation of JSON document and implementing data manipulation.
4. Creation of RDF document and using it with SPARQL.
5. Exploring the significance of SSB and in memory databases.
6. Working with MongoDB for data manipulation.
7. Sharding and Replications using MongoDB environment.
8. Study of HBase.
9. Exploring Casandra.
10. Understanding consistency Model in MongoDB.
11. Creating an Assessing Assets.
12. DA on technologies and search strategies.
13. Digital preservation strategies.
14. Using digital Asset API.
15. Study of Brand and Right Management.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Able to handle data through XML format and use associated technologies.
2. Use the ISON document databases and manipulation of data.
3. Handle the graph and column databases.
4. Handle large volume of data with distributed database patterns.
5. Get an insight about digital asset management and using search strategies.
6. Use the digital asset API to handle various digital assets.

REFERENCES:

1. Guy Harrison,Next Generation Databases - "NoSQL, NewSQL, and Big Data", Apress, 2015.
2. Elizabeth Ferguson Keathley, Digital Asset Management - "Content Architectures, Project Management and creating order out of Media Choas", Apress, 2014
3. Digital Asset Management (DAM) API Guide.

CA5107	NETWORK PROGRAMMING AND DEVICE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of networking, network security and network programming.
- To explore the end to end issues in data communication and possible secure solutions.
- To study about routing algorithms and protocols, IP and related protocols
- To understand medium access control and LANs
- To learn about networking devices and the techniques required to monitor and manage them

UNIT I ARCHITECTURE AND APPLICATION 9

Data networks –Network Architecture - ISO/OSI and TCP/IP reference models —HTTP and HTTPS, FTP, E-mail and DNS

Suggested Activities:

- Accessing HTTP and SMTP server through Telnet
- External learning - HTTP/DNS format using a tool like Wireshark.
- External learning - POP3 and IMAP protocols of email application

Suggested Evaluation Methods:

- Quiz on Wireshark.
- Quiz on POP3 and IMAP.
- Assignment problems different Application protocols

UNIT II SOCKET PROGRAMMING 9

System calls and socket programming, Elementary TCP and UDP socket - Developing client/server applications –Socket Options - Advanced Socket IP options for IPv6 server and client's interoperability- Raw Sockets.

Suggested Activities:

- Assignments on client/server programming
- Assignment on socket options for specific scenarios.
- Practical - Implementation of DNS operation with gethostbyname, gethostbyaddr, getservbyname and getservbyport functions

Suggested Evaluation Methods:

- Quizzes on System calls
- Quiz on raw sockets
- Testing for the respective socket option's role in the scenario chosen.

UNIT III SECURE COMMUNICATION 9

Secured Data Networks – CIA triangle - Encryption and Decryption – Symmetric and Asymmetric Cryptosystems -End to end issues – Transport layer protocols – TCP extensions – IPSec – SSL and TLS protocols.

Suggested Activities:

- Exploring TCP Vegas and TCP Reno
- Flipped classroom on basic encryption and decryption techniques

Suggested Evaluation Methods:

- Quiz on IPSec
- Quizzes on SSL and TLS.

Attested

UNIT IV L2 AND L3 PROTOCOLS AND DEVICES 9

Medium Access Control – Ethernet – CSMA/CD – IEEE 802.11 WLAN – CSMA/CA – IPv4 –

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Addressing, VLSM, CIDR - IPv6 – Network devices – Hubs, Bridges, Switches, Routers, L3 Switches.

Suggested Activities:

- Discussion on deterministic and non-deterministic MAC protocols
- Flipped classroom on basic of IPv4
- Flip classroom: Configuring routers and congestion control in network layer

Suggested Evaluation Methods:

- Analyzing CSMA/CA for various scenarios in terms of hidden and exposed station problems
- Problem solving in VLSM and CIDR
- Assignment on migration from IPv4 to IPv6

UNIT V DEVICES, MONITORING AND MANAGEMENT 9

Edge and Core Networks – Introduction to SDN- data plane- control plane Honeypots – Firewalls – Network monitoring - IDS – Network Management System – SNMP and its variants

Suggested Activities:

- Extra learning: Datadog Network Performance Monitoring (FREE TRIAL)
- Flipped classroom: Configuring routers and congestion control in network layer
- Tutorial on SNORT

Suggested Evaluation Methods:

- Designing networks using various networking devices as per the given specifications
- Assignment on widely used IDSs and network management tools

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Design and implement simple client/server programs using socket options.
2. Design and implement simple cryptosystems
3. To configure various transport layer level parameters in setting up a network
4. To configure various network level parameters in setting up a network
5. Experiment with various tools to manage a network
6. Design a network as per the given specifications, monitor and manage the networks

REFERENCES

1. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, Seventh Edition, Pearson Education, 2016.
2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
3. William Stallings, “Data and Computer Communications”, Eighth Edition, Pearson Education, 2011.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, " Computer Networks: An Open Source Approach", First Edition, McGraw Hill, 2011.
5. W. Richard Stevens, “TCP/IP illustrated-The Protocols”, Volume 1, Pearson Education, 2012.
6. W. Richard Stevens, Bill Fenner, Andrew M Rudoff “UNIX Network Programming: The Sockets Networking API“, Volume 1, Third Edition, Pearson Education, 2015.

RM5151	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

OBJECTIVES:

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 PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, Second Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

CA5111	PROGRAMMING IN PYTHON LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the problem-solving approaches.

- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Practical - Implementing real-time/technical applications using Lists, Tuples.
5. Practical - Implementing real-time/technical applications using Sets, Dictionaries.
6. Practical - Implementing programs using Functions.
7. Practical - Implementing programs using Strings.
8. Practical - Implementing programs using written modules and Python Standard libraries.
9. Practical - Implementing real-time/technical applications using File handling.
10. Practical - Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race, etc.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Develop algorithmic solutions to simple computational problems
2. Develop and execute simple Python programs.
3. Structure simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python data structures.
6. Apply Python features in developing software applications.

CA5113	DATA STRUCTURES & ALGORITHMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the usage of advanced tree structures.
- To familiarize the usage of heap structures.
- To learn the usage of graph data structures and spanning trees.
- To learn how to analyze the complexities of algorithms.
- To explore the various design strategies of algorithms.

EXPERIMENTS:

1. Implementation of Stack ADT, Queue ADT, and List ADT.
2. Implementation of Binary Search tree and its operations.
3. Implementation of AVL tree and its operations.
4. Implementation of Hashing techniques such as quadratic probing and separate chaining.
5. Implementation of basic heap operations.
6. Implementation of representation of graphs and topological sort.
7. Implementation of a spanning tree for a given graph using Prim’s algorithm.
8. Implementation of shortest path algorithms such as Dijkstra’s algorithm.
9. Implementation of iterative and recursive algorithms with its complexity analysis.
10. Implementation of merge sort algorithm analysis using divide and conquer approach.
11. Implementation of matrix chain multiplication using dynamic programming approach.
12. Implementation of Huffman coding using greedy approach.

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TOTAL: 60 PERIODS

OUTCOMES:

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

1. Implement basic and advanced data structures extensively.
2. Choose and apply suitable hierarchical data structures for real time problems.
3. Apply suitable heap data structures based on the problem requirements.
4. Design and apply algorithms using graph structures.
5. Design and implement iterative and recursive algorithms with minimum complexity.
6. Design and develop efficient algorithms by adopting suitable algorithm design strategies.

CA5206	DATA ANALYTICS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To know the fundamental concepts of data science and analytics.
- To learn fundamental data analysis using R.
- To understand various data modeling techniques.
- To learn the basic and advanced features of open source big data tools and frameworks.
- To study various analytics on stream data.

UNIT I INTRODUCTION TO DATA SCIENCE AND BIG DATA 9

Introduction to Data Science – Data Science Process – Exploratory Data analysis –Collection of Data – Graphical Presentation of Data – Classification of Data – Storage and Retrieval of Data, Big data: Definition, Risks of Big Data, Structure of Big Data – Web Data: The Original Big Data – Evolution Of Analytic Scalability – Analytic Processes and Tools – Analysis versus Reporting – Core Analytics versus Advanced Analytics– Modern Data Analytic Tools – Statistical Concepts: Sampling Distributions – Re-Sampling – Statistical Inference – Introduction to Data Visualization.

Suggested Activities:

- Case studies on big data application domain.
- Solving numerical problems in sampling, hypothesis testing.
- Converting real-time decision-making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on big data applications with societal need.
- Quizzes on sampling and statistical testing.

UNIT II DATA ANALYSIS USING R 9

Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis – Bivariate Analysis: Correlation – Regression Modeling: Linear and Logistic Regression – Multivariate Analysis – Graphical representation of Univariate, Bivariate and Multivariate Analysis in R: Bar Plot, Histogram, Box Plot, Line Plot, Scatter Plot, Lattice Plot, Regression Line, Two-Way cross Tabulation.

Suggested Activities:

- Practical - Perform univariate analysis on UCI datasets.
- Solve numerical problems in correlation and regression using sample real time data.
- Practical - Implement univariate, bivariate and multivariate analysis using R Studio.
- Given a data set, explore the features using data analysis in R.

Suggested Evaluation Methods:

- Assignment on univariate, bivariate and multivariate analysis.

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- Demonstrate implementation of univariate, bivariate and multivariate analysis using R Studio.
- Assignment on comparative analysis of the two or more data sets using their features.

UNIT III DATA MODELING 9

Bayesian Modeling – Support Vector and Kernel Methods – Neuro – Fuzzy Modeling – Principal Component Analysis – Introduction to NoSQL: CAP Theorem, MongoDB: RDBMS Vs MongoDB, Mongo DB Database Model, Data Types and Sharding – Data Modeling in HBase: Defining Schema – CRUD Operations.

Suggested Activities:

- Practical - Implementation of Bayesian modeling using Weka tool.
- Practical - Given a data set, apply Bayesian and neural models using open source data modeling tools.
- Solve numerical problems on Eigen Value, Eigen Vector, etc. to understand the working principles of mining techniques.
- Demonstration on data distribution in HBase and MongoDB.

Suggested Evaluation Methods:

- Implementation demonstration of Bayesian modeling and other simple data preprocessing tasks using Weka tool.
- Implementation demonstration of practical exercises.
- Mini project (individual) - Given a data set and decision-making scenario identify suitable modeling technique(s) and implement using Weka tool.

UNIT IV DATA ANALYTICAL FRAMEWORKS 10

Introduction to Hadoop: Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Introduction to MapReduce – Running Algorithms Using MapReduce – Introduction to HBase: HBase Architecture, HLog and HFile, Data Replication – Introduction to Hive, Spark and Apache Sqoop.

Suggested Activities:

- Case studies on MapReduce for text mining and simple linear problems using numerical methods.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) - Real time data collection, saving in Hive, implement analytical techniques using MapReduce tasks and result projection.

UNIT V STREAM ANALYTICS 8

Introduction to Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window.

Suggested Activities:

- Case studies on the usage of stream analytics in popular search engines.
- External learning - Real time sentiment analysis, stock market predictions.
- Assignments on solving simple numerical problems involving moments and skewness.

Suggested Evaluation Methods:

- Assignment on the following given a problem scenario identify suitable stream analytical technique(s).
- Quiz on all topics covered in stream analytics.

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EXPERIMENTS: 30

Do the following experiments using R/Python:

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1. Download, install and explore the features of R/Python for data analytics.
2. Use the Diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
   a. Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
   b. Bivariate Analysis: Linear and logistic regression modeling.
   c. Multiple Regression Analysis
   d. Also compare the results of the above analysis for the two data sets.
3. Apply Bayesian and SVM techniques on Iris and Diabetes data set.
4. Apply and explore various plotting functions on UCI data sets.
5. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API
6. Implement univariate, bivariate, and multivariate analysis using R Studio.
2. Given a data set, explore the features using data analysis in R.
3. Solve numerical problems on Eigen Value, Eigen Vector, etc. to understand the working principles of mining techniques.
4. Implement an MR program that processes a weather dataset R
5. Implement the following using Hadoop, Map Reduce, HDFS, Hive:
   a. Perform setting up and Installing Hadoop in its two operating modes: pseudo distributed and fully distributed.
   b. Implement the following file management tasks in Hadoop: adding files and directories, retrieving files and Deleting files.
   c. (i)Performing a MapReduce Job for word search count (look for specific keywords in a file)
      (ii) Implement stop word elimination problem: Input a large textual file containing one sentence per line and a small file containing a set of stop words (one stop word per line) and save the results in an output textual file containing the same sentences of the large input file without the words appearing in the small file.
   d. Implement a MapReduce program that processes a weather data set to:
      i. Find average, max and min temperature for each year in National Climate Data Centre data set.
      ii. Filter the readings of a set based on value of the measurement. The program must save the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.
   e. Install, deploy & configure Apache Spark cluster. Run Apache Spark applications using Scala.
   f. Install and run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Convert real world problems to hypothesis and perform statistical testing.
2. Perform data analysis using R.
3. Work with big data platform and its analysis techniques.
4. Identify and design efficient modeling of large data.
5. Implement suitable data analysis for stream data.
6. Write efficient MapReduce programs for small problem-solving methods.

REFERENCES:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.

3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Nishant Garg, “HBase Essentials”, Packt, 2014.
5. Rachel Schutt, Cathy O'Neil, “Doing Data Science”, O'Reilly, 2013.
6. Foster Provost, Tom Fawcet, “Data Science for Business”, O'Reilly, 2013.
7. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley, 2014.

CA5207	ADVANCED JAVA PROGRAMMING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the object-oriented concepts of Java.
- To learn GUI based application development and network programming.
- To build dynamic web sites using server-side technologies with database connectivity.
- To learn the concepts of distributed objects, messaging, and mail services.
- To understand the importance of advanced frameworks.

UNIT I JAVA BASICS 9

Overview of Java – Java Fundamentals: Classes, Objects, Methods and Strings – Methods: A Deeper Look – Arrays and Array Lists – Classes and Objects: A Deeper Look – Inheritance – Polymorphism – Interfaces – Packages – Exception Handling – Strings, Characters and Regular Expressions.

Suggested Activities:

- Flipped classrooms on basics of Java.
- Learning and Implementation in the following topics.
    - Create and manipulate character – string objects of class String, String Builder and Character.
    - Creating applications using system and user defined exceptions.

Suggested Evaluation Methods:

- Quiz on Java fundamentals.
- Demonstration of Java programs with object-oriented features.

UNIT II GUI, I/O AND NETWORK PROGRAMMING 9

Graphics and Java 2D – Basics of Swings – I/O, Streams and Object Serialization – Recursion – Threads – Multithreading – Generic collections – Generic Classes and Methods – Networking Manipulating URLs – Reading web pages – Using stream sockets – Datagrams – Broadcasting – Multicasting – Chat application.

Suggested Activities:

- Learning and implementation in the following topics.
    - Java I/O Streams for text and binary data operations to read from and write to files.
    - Java Applications using Generics.
    - Java Frame and Applet based Application Development.
    - Java based thread implementation using thread priorities.
    - Java networking applications using sockets and datagrams.

Suggested Evaluation Methods:

- Quiz on generics and networking.
- Tutorial assignments on advanced Java features.

UNIT III JDBC AND WEB APPLICATION DEVELOPMENT 9

Accessing Database with JDBC – Basics – Manipulating Databases with JDBC – Overview of JSP – JSP Objects - Running JSP with Database Connectivity – Session Tracking – Java Server Faces

– Multitier Application Architecture – MVC Architecture of JSF Apps – Common JSF Components – Session Tracking.

Suggested Activities:

- Developing a database application using JDBC.
- Creation of simple servlet-based application.
- Creation of JSF application and managing sessions.

Suggested Evaluation Methods:

- Quizzes on database application using JDBC.
- Demonstration of web applications developed using JSP and JSF.

UNIT IV DISTRIBUTED OBJECTS 9

RMI Programming Model – Remote Object Activation – Java Beans Component – Java Beans API – Java Messaging Services (JMS) – Synchronous and Asynchronous Messaging – Java Mail API – Java Web Services.

Suggested Activities:

- Developing distributed applications using RMI and Java Bean.
- Development of synchronous and asynchronous Java based messaging services.
- Creation of a SOAP and RESTful based web services.

Suggested Activities:

- Quiz on RMI, XML and web services.
- Demonstration of RMI, XML and web services implementation.

UNIT V: ADVANCED FRAMEWORKS 9

Advanced Frameworks – Understanding Struts – MVC framework – Struts Control Flow – Building Model View Controller Component – Hibernate – Architecture – Understanding O/R mapping – Query language – Spring Framework – Architecture – Case Studies.

Suggested Activities:

- Flipped classroom on MVC Architecture

Practical Learning:

- Create a simple application using struts.
- Hibernate framework-based O/R mapping.
- To create simple applications using Spring framework.

Suggested Evaluation Methods:

- Demonstration on Hibernate, Struts and Spring framework-based application.

EXERCISES: 30

1. Design and Implement Java programs that deals with the following:
    a. Classes and Objects and Interfaces.
    b. Exception Handling with user defined Exceptions.
    c. String Handling (String Class objects – string manipulation functions).
    d. Streaming (image file handling using byte streams – text file manipulation using character streams).
    e. Implementation of Thread Synchronization using any application.
    f. Reading and Writing Objects using Serialization.
    g. Creation of User Interfaces using SWING and graphic features.
    h. Creation and Manipulation of generic objects.
2. Java socket programming.
    a. Implementation of chat client-server application.

b. Implementation of simple http client/server application.
c. Simulation of DNS protocol.

3. Reading websites using URL class.
4. Implementation of any Information System using JDBC.
5. Remote Method Access using RMI Implementation.
6. Database Connectivity using Java Bean.
7. Web Application development using JSP and JSF.
8. Session Management and Implementation of Cookies using JSF.
9. Development of SOAP and REST based web services.
10. Development of Hibernate framework-based application for O/R mapping.
2. Web application development using Struts framework &Spring framework.
3. Analyze live HTTP/DNS/UDP/TCP/IP/ICMP/DHCP packets using Wireshark tool.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Practical - implement object-oriented concepts of Java programming.
2. Work with Generics, networking and GUI based application development.
3. Develop dynamic web applications with database connectivity using server-side technologies.
4. Create distributed applications using RMI, Java Bean and web services.
5. Design and development of applications using advanced frameworks.
6. Understand the importance of advanced frameworks.

REFERENCES:

1. "Core and Advanced Java, Black Book", Dreamtech Press, 2018.
2. Paul J. Deitel, Harvey Deitel, "Java How to Program", Eleventh Edition, Pearson, 2017.
3. Cay S.Horstmann, "Core Java Volume I & II", Pearson Education, 2018.
4. Herbert Schildt , "Java The Complete Reference", Eighth Edition, Tata McGraw Hill, 2011.
5. Paul Dietel, Harvey Dietel, Abbey Dietel, "Internet and World Wide Web", Fifth Edition, Pearson Education, 2012.

CA5208	FULL STACK SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of JavaScript and importance of MERN stack
- To understand the role of React in designing front-end components
- To understand the design issues in the development of backend components using Node.js and Express
- To understand the significance of using MongoDB as a database system
- To understand the advanced features of full stack development

UNIT I JAVASCRIPT AND BASICS OF MERN STACK 9

JavaScript Fundamentals - Objects - Generators, advanced iteration - Modules - DOM tree - Node properties - browser events - Event delegation - UI Events -Forms, controls - Document and resource loading - Mutation observer - Event loop: microtasks and macrotasks - MERN Components - React - Node.js - Express - MongoDB - Need for MERN - Server-Less Hello World - Server Setup - nvm - Node.js - npm.

Suggested Activities:

- Modern JavaScript features-based programming
- Setting up MERN environment
- Simple programs in MERN environment

Suggested Evaluation Methods:

- Programming exercise on JavaScript basic and advanced features
- Case study based simple projects

UNIT II REACT 9

React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes - Composing Components - Passing Data - Dynamic Composition - React state - setting State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms - React CSS - React SaaS

Suggested Activities:

- REACT based programming
- Exploring stateless components
- Designing components with React CSS and SaaS

Suggested Evaluation Methods:

- Programming exercise on REACT based component development
- Simple projects for specific use cases

Unit III NODE.JS AND EXPRESS 9

Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js EventEmitter - Frameworks for Node.js - Express.js Web App - Serving static Resource - Node.js Data Access - Express REST APIs - REST - Resource Based - HTTP Methods as Actions - JSON- Express - Routing - Handler Function - Middleware - The List API - Automatic Server Restart - Testing - The Create API - Using the List API - Using the Create API- Error Handling - Template Engine.

Suggested Activities:

- Node and Express based web development Handling of various APIs associated with Node.js

Suggested Evaluation Methods:

- Programming exercise on Node.js based development
- Simple projects for specific use cases

Unit IV MONGODB 9

MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD operations - projections - Indexing - Aggregaton - Replication - Sharding - Creating backup – Deployment.

Suggested Activities:

- Setting up MongoDB and handling data manipulation
- Querying the MongoDB databases
- Exploring Arregation, Replication, Sharding and other features in MongoDB

Suggested Evaluation Methods:

- Data manipulation exercises (CRUD) / assignments using MongoDB
- Simple projects for specific use cases

Unit V ADVANCED FEATURES 9

Modularization and Webpack - Routing with React Router - Forms - More Filters in the List API - UI Components - Update API - Delete API - React-Bootstrap - Bootstrap Installation - Navigation - Table and Panel - Forms - Alerts - Modals -Server Rendering - Basic Server Rendering - Handling State - MongoDB Aggregate - Pagination - Higher Order Components - Search Bar - Google Sign-In - Session Handling

Suggested Activities:

- Experiments on React Router and various APIs
- Server rendering and handling states
- Session handling

Suggested Evaluation Methods:

- Assignments on using various APIs
- Simple projects for specific use cases

TOTAL: 45 PERIODS

REFERENCES

1. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, A Press Publisher, 2019.

Web Reference

- http://tutorialsteacher.com
- https://reactjs.org/
- https://nodejs.org
- www.Expressjs.com
- www.mongodb.com

CA5209	CLOUD COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the concepts of distributed systems.
- To understand distributed resource management.
- To study the basics of cloud computing.
- To study about virtualization and cloud resource management.
- To be aware of different cloud platforms.

UNIT I INTRODUCTION TO DISTRIBUTED SYSTEM CONCEPTS 9

Introduction to Distributed Systems – Characteristics – Issues in Distributed Systems –Distributed System Model – Request/Reply Protocols – RPC – RMI – Logical Clocks and Casual Ordering of Events – Introduction to Web Service and Service Oriented Architecture – SOAP – REST– Introduction to OS Concepts – ISA, Emulation, Process and Memory Management.

Suggested Activities:

- Practical - Implement RPC.
- Create and distribute a Torrent file to share a file in LAN environment.
- Create a simple web service using Python Flask/Java/any language [Web Service: Client-server model should be implemented using socket/http].

Suggested Evaluation Methods:

- Demonstration and assessment of the implemented algorithms.
- Review web services implementation - Proper Connection should be established between the client and server to make use of the service offered by the Server.

UNIT II INTRODUCTION TO CLOUD COMPUTING 8

Introduction to Cloud Computing – Evolution of Cloud Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning – NIST Cloud Computing Reference Architecture – Architectural Design Challenges – Cloud Deployment Models: Public, Private and Hybrid Clouds – Cloud Service Models: IaaS, PaaS, SaaS Models – Benefits of Cloud Computing – Overview of Cloud Standards.

Suggested Activities:

- Explore public cloud services like Amazon, Google, Sales Force, Digital Ocean, Azure

Suggested Evaluation Methods:

- Quizzes on different service models and deployment models.
- Report submission - Comparison of various services provided by different Cloud public Service Providers (configuration of VM, cost, network bandwidth etc.).

UNIT III CLOUD ENABLING TECHNOLOGIES 8

Basics of Virtualization – Full and Para Virtualization– Implementation Levels of Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization – Server Virtualization – Application and Database Virtualization with Multitenancy – Virtual Desktop Infrastructure – Docker Containers.

Suggested Activities:

- Install Oracle Virtual Box/VMware Workstation and create a chat application [***Note:*** Launch two virtual machines for chat application].
- Install Docker and create containers.

Suggested Evaluation Methods:

- Review the working of application in virtual environment.
- Evaluate the working of any application in the container created.

UNIT IV CLOUD MANAGEMENT, STORAGE AND SECURITY 10

Cloud Management Products – Cloud Storage – Provisioning Cloud Storage – Managed and Unmanaged Cloud Storage – Cloud Security Overview – Cloud Security Challenges – Security Architecture Design – Virtual Machine Security – Application Security – Data Security – Cloud Networking – Introduction to Software Defined Networking and Network Function Virtualization – Automation with DevOps.

Suggested Activities:

- Use security tools like OSSEC, ETTERCAP for finding security vulnerabilities.
- Deploy Open vSwitch or Mininet to explore cloud networking model.

Suggested Evaluation Methods:

- Report submission - Generate a detailed report describing vulnerabilities.

UNIT V CLOUD SOFTWARE AND COMPUTING PLATFORMS 10

Google App Engine (GAE) – Programming Environment for GAE – Google Cloud Platform – AWS – OpenStack – VMWARE.

Suggested Activities:

- Install and configure OpenStack all-in-one using DevStack/Packstack and launch VMs in OpenStack through dashboard.

Suggested Evaluation Methods:

- OpenStack Dashboard should be accessed through web browser. Verify the working of instance by logging into it/pinging the instance.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Appreciate distributed computing, distributed resource management.
2. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
3. Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
4. Explain the core issues of cloud computing such as resource management and security.

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5. Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.
6. Establish own cloud environment using Openstack and work on it.

REFERENCES:

1. Andrew S. Tanenbaum, Maarten Van Steen, “Distributed Systems - Principles and Paradigms”, Second Edition, Pearson, 2006.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann, 2012.
3. Mukesh Singhal, "Advanced Concepts In Operating Systems", McGraw Hill, 1994.
4. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, John Wiley& Sons, 2011.
5. John W. Ritting house, James F. Ransome, "Cloud Computing: Implementation "Management, and Security", CRC Press, 2010.

CA5213 FULL STACK LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To learn and implement JavaScript features.
- To learn the browser-based JavaScript features in a web based environment
- To understand and develop front end UI development using React JS.
- To understand and design back end development using Node.js and Express.
- To learn NoSQL data technologies and data management with web application

EXERCISES

- Simple exercise on JavaScript Objects, Generators, advanced iteration, and Modules.
- Working with DOM tree, node properties, browser events, UI Events, Forms, controls, Document and resource loading, Mutation observer, microtasks and macrotasks.
- Front end UI development with React JSX, components, React Classes, Composing Components, React state, Async State, Event Handling, Stateless Components. Working with React Forms - React CSS - React SaaS
- Application backend development with Node.js and Express
- Handling NoSQL data using MongoDB and manipulating data and management.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Implement and execute basic JavaScript programs.
2. Work with react based framework for front end development.
3. Work with back end technologies such as nodeJS and express.
4. Handle data and manage using Mango DB as a database for enterprise app development.
5. Get an insight about the advanced features such as routing, Filters, bootstrap.
6. Work with Mango DB based aggregate, pagination and higher order components.

CA5511 MOBILE APPLICATION DEVELOPMENT LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To understand the need and characteristics of mobile applications.
- To design the right user interface for mobile application.
- To understand the design issues in the development of mobile applications.
- To understand the development procedure for mobile application.
- To develop mobile applications using various tools and platforms.

EXPERIMENTS:

1. Develop an application that uses GUI components, font and colours.
2. Design an application that uses Layout Managers and event listeners.
3. Develop a native calculator application.
4. Design an application that draws basic graphical primitives on the screen.
5. Develop an application that makes use of mobile database.
6. Develop an application that makes use of internet for communication.
7. Implement an android application that writes data into the SD card.
8. Implement an application that creates an alert upon receiving SMS message.
9. Develop a native application that uses GPS location information.
10. Develop a mobile application that creates a notification as task reminder.
11. Develop an android application using telephony to send SMS.
12. Implement primitive graphics in android application for color fill in objects.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Design the right user interface for mobile application.
2. Implement mobile application using UI toolkits and frameworks.
3. Design mobile applications that are aware of the resource constraints of mobile devices.
4. Develop web based mobile application that accesses internet and location data.
5. Implement android application to use telephony for SMS communication.
6. Implement android application with multimedia support.

CA5304	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Search techniques
- To understand the reasoning methods in Intelligent systems
- To understand the basic concepts of machine learning and probability theory.
- To appreciate supervised learning and their applications.
- To understand unsupervised learning like clustering and EM algorithms.

UNIT I AGENTS AND SEARCH 9

Agents and Environments – Good Behavior: The Concepts of Rationality – The Nature of Environments – The Structure of Agent - Problem Solving by Search – Uninformed Search – Searching with Costs – Informed State Space Search: Greedy and A* search – Game Search – Constraint Satisfaction Problems.

Suggested Activities

- Flipped classroom on structure of agents.
- Flipped classroom on uninformed search - searching with costs.
- In-class activity on solving puzzles with uninformed and informed searches.

Suggested Evaluation Methods

- Assignments on puzzles with uninformed and informed searches.
- Quizzes on environments and search
- Evaluation of the programming exercises.

UNIT II LOGIC AND REASONING 9

Proposition Logic - Syntax - Semantics - First Order Logic - Syntax - Semantics - Conversion from English Statements to First order logic formula - Reasoning methods - Forward chaining - Backward chaining – Resolution – Introduction to Probabilistic Reasoning

Suggested Activities:

- Reasoning methods through puzzles and real-life scenarios.
- Practical - Inference through Prolog/Python.

- Practical - Programming through Prolog/ Python for various topics such as reasoning through resolution.

Suggested Evaluation Methods:

- Tutorials on reasoning methods.
- Assignments on different topics of the unit.
- Quizzes on inference techniques in logic.
- Evaluation of the programming exercises.

UNIT III BASICS OF MACHINE LEARNING 9

Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory – Turning Data into Probabilities – The Bias-Variance Tradeoff.

Suggested Activities:

- Flipped classroom on Artificial Intelligence and Expert Systems.
- Practical - Installing Python and exploring the packages required for machine learning including numpy, scikit-learn, and matplotlib, IPython hmmpytk and pgmpy.

Suggested Evaluation Methods:

- Assignments on different types of learnings.
- Tutorials on probability theory.

UNIT IV SUPERVISED LEARNING 9

Linear Models for Regression –The Bias-Variance Decomposition –Common Regression Algorithms – Simple Linear Regression – Multiple Linear Regression – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Naive Bayesian Classifier - Probabilistic Discriminative Models – Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines.

Suggested Activities:

- Flipped classroom on basics about classification and regression.
- Practical - Collection of data from different resources and summarize the data.
- Practical - Build linear, multi-linear, logistic regression model to predict the data.

Suggested Evaluation Methods:

- Evaluation of the practical assignment against appropriate test sets.

UNIT V UNSUPERVISED LEARNING 9

Mixture Models and EM – K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models (LVM) – Latent Dirichlet Allocation (LDA).

Suggested Activities:

- Flipped classroom on mixture models.
- External learning - Improving performance of the model using kernel methods.

Suggested Evaluation Methods:

- Assignments on mixture models.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Apply the search techniques to real-time problems
2. Understand the underpinnings of Logic and Reasoning
3. Choose and implement classification or regression algorithms for an application using an open source tool.
4. Implement probabilistic discriminative and generative algorithms for an application and analyze the results.

5. Use a tool to implement typical clustering algorithms for different types of applications.
6. Implement appropriate learning algorithms for any real time application using an open source tool.

REFERENCES:

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence - A modern Approach Third Edition, Pearson Publishers, 2015
2. EthemAlpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2015.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, CRC Press, 2014.
4. Tom Mitchell, “Machine Learning”, McGraw-Hill, 2017.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008.
6. Fabio Nelli, “Python Data Analytics with Pandas, Numpy, and Matplotlib”, Second Edition, Apress, 2018.

CA5305	INTERNET OF THINGS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To build a small low-cost embedded system using Arduino / Raspberry Pi or equivalent boards.
- To learn communication protocols that is frequently used in IoT ecosystems.
- To explore the ways of processing enormous amount of data generated in IoT based systems.
- To understand the role of cloud computing in IoT and to become familiar with various cloud offerings.

UNIT I ENABLING TECHNOLOGIES AND REFERENCE MODELS 9

Sensors and Actuators – Centralized Sensing vs Distributed Sensing – Making Physical Objects as Smart Objects – Enabling Technologies – Wireless Sensor Networks, Cloud Computing and Data Analytics – IoT vs M2M – Possible IoT Reference Models – Domain Specific IoTs – Levels of IoT Based Systems.

Suggested Activities:

- Flipped classroom on enabling technologies.
- External learning – Exploring proprietary protocols used in IoT and M2M.
- Analyzing the required level of design for different IoT based ecosystems.

Suggested Evaluation Methods:

- Quiz and discussion on enabling technologies (WSN, Cloud and Big Data).
- Assignments on proprietary protocols used in IoT and M2M.
- Deciding the level and designing the IoT framework for case studies.

UNIT II DESIGN OF END DEVICES 9

Microprocessors vs. Microcontrollers – Open Source Movement in Hardware – Engineering vs Prototyping – Software Development Lifecycle for Embedded Systems – Arduino IDE – Programming and Developing Sketches – Arduino Rest APIs – Raspberry Pi – Interfaces – Python Packages of Interests for IoT

Suggested Activities:

- Flipped classroom on open source movement in hardware and SDLC for embedded systems.
- Explore the variants of Arduino Boards, Atmel Microcontrollers, Cypress Pioneer and NXP Freedom.
- Learning to write Arduino Sketches and Python programs.

Suggested Evaluation Methods:

- Quiz and discussion on open source movement in hardware and SDLC for embedded systems.
- Assignments on Arduino boards, Atmel Microcontrollers, Cypress Pioneer and NXP Freedom.
- Practical – Developing Arduino Scripts and Python programs.

UNIT III IoT PROTOCOLS 9

MAC Layer Protocols – IEEE 802.15.4 – G and E Variants of IEEE 802.15.4 – IEEE 802.11ah – IEEE 1901.2a – LoRaWAN – 6LoWPAN – From 6LoWPAN to 6Lo – NBIoT – REST Based Protocols – SCADA, CoAP and MQTT

Suggested Activities:

- External learning – Explore various software tools that support CoAP and MQTT.
- Flipped classroom on role of Ipv6 in designing IoT based systems.
- Analyze Cisco Reference Model and IBM Reference Models.

Suggested Evaluation Methods:

- Assignments on software tools that support Coap and MQTT.
- Quiz and discussion on role of Ipv6 in IoT based systems.
- Assignments on the IoT policy of Meity (Government of India).

UNIT IV INDUSTRIAL IoT 9

Industrial IoT adoption – IIoT Challenges, Drivers and Taxonomies – Industry 4.0- Areas of IIoT Adoption –Tools and Technologies assisting IIoT – Case studies, Retail Industry, Home automation, Manufacturing Automation, Energy management, Health care and Workflow Management.

Suggested Activities:

- External learning – Industry 5.0 (Exploring scalability, security, and customization).
- Flipped classroom on IIoT business Models.
- Learning and Imbibing Green IoT.

Suggested Evaluation Methods:

- Assignments on emerging areas of Industry 5.0.
- Quiz and group discussion on technologies for IIoT business Models.
- Practicing green framework for IoT application (expeditionary learning- project based)

UNIT V IoT ANALYTICS 9

Lambda Architecture – Flexible Netflow Architecture – Providing Multiservice in IoT using FNF Components. Cloud Storage Models and Communication API – WAMP AutoBahn – Xively Cloud – Python Web Application Framework – Django –IBM Watson – AWS for IoT – Case Studies.

Suggested Activities:

- Flipped classroom on cloud models and type of clouds.
- External learning – Django framework.

Suggested Evaluation Methods:

- Quiz and discussion on cloud models and types of clouds.
- Developing web apps for IoT ecosystems using Django framework.

PRACTICAL EXERCISE: 30

1. Develop a BLINK sketch in Arduino.
2. Develop an Arduino sketch that repeats an LED to glow brightly, decrease the brightness, switches off the LED, increases the brightness and LED glows with maximum intensity (a sketch for fading).
3. Develop an Arduino sketch that takes sensor readings for five seconds during the startup and tracks the highest and lowest values it gets. These sensor readings during the first five

seconds of the sketch execution define the minimum and maximum of expected values for the readings taken during the loop (a sketch for calibrating a sensor).
4. Develop an Arduino sketch that reads the value of a variable resistor as an analog input and changes blink rate of the LED.
5. Develop an Arduino sketch to use a piezo element to detect the vibration.
6. Develop a Python program to control an LED using Rapberry Pi.
7. Develop a Python program to interface an LED with a switch using Rapberry Pi.
8. Implement a map reduce program that produces a weather data set.
9. Implement an application that stores big data in Hbase/Mongo DB using Hadoop/R.
10. Use Google Collaboration Tools: Create Google Docs, Sheets, and Slides and share it with others.
11. Mini project.

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Understand the enabling technologies and reference models of IoT.
2. Design portable IoT devices using Arduino IDE/ Raspberry Pi with Python.
3. Apply appropriate protocols in various parts of IoT based systems.
4. Understand Big Data tools and technologies and apply them in IoT based systems.
5. Design and deploy IoT based systems and connect them to cloud offerings.
6. Design IoT systems for various real time applications.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A Hands-On Approach”, Universities Press, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.
3. David Hanes, Gonzalo Salguerio, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for Internet of Things”, Cisco Press, 2017.
4. Perry Lea, “Internet of Things for Architects”, PACKT, 2018.
5. Ravi Ramakrishnan, Lovleen Gaur, “Internet of Things: Approach and Applicability in Manufacturing”, CRC press, Taylor, and Francis First Edition, 2019.

CA5306	CYBER SECURITY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To introduce the concepts and models of security.
- To understand the risk assessment and security standard.
- To plan for business continuity and incident response plan.
- To estimate the level of security risk faced by an organization and the counter measures to handle the risk.
- To understand potential vulnerabilities and to develop a security blueprint.

UNIT I INTRODUCTION TO SECURITY & SECURITY MODELS 9

Security Trends – OSI Security Architecture – Security Attacks – Security Services– Security Mechanisms– Security System Development Life Cycle – Security Models – Bell – LaPadula Model – Biba Integrity Model – Chinese Wall Model ;Authentication, Identification Versus Authentication, Authentication Based on biometrics, Authentication Based on Tokens, Federated Identity management, Multifactor Authentication, Secure Authentication, Authorization, Privacy, Piracy, Implementing Access Control, Procedure-Oriented Access Control, Role-Based Access Control, Attackers and attack types, Digital Rights Management.

Suggested Activities:

- In-class activity to learn about various security services and attacks.
- In-class activity to understand importance of various security models.
- External learning - Virus programs to demonstrate the virus attack.

Suggested Evaluation Methods:

- Assignment on SecSDLC to understand about the importance of each models.
- Quiz on Security attacks and services.

UNIT II SECURITY ANALYSIS AND LOGICAL DESIGN 9

Risk Management – Identifying and Assessing Risk – Assessing and Controlling Risk – Blueprint for Security – Information Security Policy – Standards and Practices – ISO 17799/BS 7799 – NIST Models – VISA International Security Model – Design of Security Architecture – Depth of Défense – Security Perimeter.

Suggested Activities:

- Design security architecture and assess the risk in web application.
- Analysis risk for any real time applications and prepare blueprint for security to controlling the risk.
- Case study of various existing ISO standard security policies.

Suggested Evaluation Methods:

- Assignment on security architecture, DoD and security perimeter.
- Quiz on security polices and ISO standards.

UNIT III PLANNING FOR CONTINUNITY 9

Continuity Strategy – Business Impact Analysis – Incident Response Planning – Incident Reaction – Incident Recovery – Automated Response – Disaster Recovery Planning – Business Continuity Planning – Model for a Consolidated Contingency Plan – Law Enforcement Involved – Physical Design of the SecSDLC.

Suggested Activities:

- Develop an attack success scenario and assess the potential damage.
- Prepare the contingency planning documents for business continuity.
- Study about the benefits and drawback of Law Enforcement Involvement.

Suggested Evaluation Methods:

- Assignment on disaster recovery planning and business continuity.
- Quiz on incident response, reaction, and recovery.

UNIT IV SECURITY ANALYSIS 9

Security Technology – Intruders, Malicious software, Firewalls, Scanning and Analysis tools, Content filters – Vulnerability Analysis – Flaw Hypothesis Methodology, NRL taxonomy and Aslam‘s model – Auditing – Anatomy of an Auditing System – Design of Auditing Systems – Posteriori Design – Auditing mechanisms.

Suggested Activities:

- Highlight different security technology and its applications.
- Discussion on scanning and analysis tools for identify the vulnerabilities.
- Prepare security auditing report of an application and understanding the vulnerabilities in the system.

Suggested Evaluation Methods:

- Assignment to learn about vulnerability, analysisflaw hypothesis methodology, NRL taxonomy and Aslam’s model.
- Quiz on intruders, malicious software, firewalls, scanning and analysis tools.

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UNIT V SECURITY PRACTICES 9

Secure Coding – OWASP/SANS Top Vulnerabilities – Buffer Overflows – XSS – Anti Cross Site Scripting Libraries – Database security – SQL Injection – Cyber Crime and security, Security tools – Digital Forensic – OS fingerprinting – TCP/IPstack Masking – Social Engineering.

Suggested Activities:

- Use various scanning tools and gather the information about the vulnerable applications.
- Simulation of the Damn Vulnerable Web application to demonstrate various attacks.
- Practical - Implement cross side scripting XSS and SQL injection in the web and database application.

Suggested Evaluation Methods:

- Assignment to understand OWASP/SANS top vulnerabilities and identify various attacks.
- Quiz on database security and social engineering.
- Demonstrate the tool to analysis various attacks like buffer overflow, XSS etc.

EXPERIMENTS 30

1. Study of System threat attacks - Denial of Services.
2. Study of Sniffing and Spoofing attacks.
3. Study of Techniques uses for Web Based Password Capturing.
4. Study of Different attacks causes by Virus and Trojans.
5. Study of Anti-Intrusion Technique – Honey pot.
6. Implement the following SUBSTITUTION & TRANSPOSITION TECHNIQUES concepts:
    a. Caesar Cipher
    b. Playfair Cipher
    c. Hill Cipher
    d. Vigenere Cipher
    e. Rail fence – row & Column Transformation
7. Implement the following algorithms
    a. DES
    b. RSA Algorithm
    c. Diffie-Hellman
    d. MD5
    e. SHA-1
8. Implement the Signature Scheme - Digital Signature Standard
9. Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG)
10. Setup a honey pot and monitor the honeypot on network (KF Sensor)
11. Installation of rootkits and study about the variety of options
12. Perform wireless audit on an access point or a router and decrypt WEP and WPA.(Net Stumbler)
13. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w)

TOTAL: 75 PERIODS

OUTCOMES:

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

1. Apply the basic security models and policies required by computing system.
2. Develop a secure application using cryptographic algorithm.
3. Able to provide the security law and policies for an organization.
4. Predict the vulnerabilities across any computing system and hence be able to design a security solution for any computing system.
5. Understand the importance of security audit and risk management of an organization.
6. Able to understand various OWASP/SANS top vulnerabilities and perform penetration testing and security measures in a given application.

REFERENCES:

1. Michael E Whitman, Herbert J Mattord, “Principles of Information Security”, Fourth Edition, Cengage Learning, 2011.

2. Matt Bishop, “Computer Security: Art and Science”, Pearson Education, 2003.
3. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, “Security in Computing”, Fifth Edition, Prentice Hall, 2015.
4. Wenbo Mao, “Modern Cryptography Theory and Practice”, Pearson Education, 2004.

CA5314 MACHINE LEARNING TECHNIQUES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To apply the concepts of Machine Learning to solve real-world problems
- To implement basic algorithms in clustering &classification applied to text & numeric data
- To implement algorithms related to dimensionality reduction

EXERCISES

1. Linear Regression and Multiple Regression
2. K-Nearest Neighbor Classifier
3. Root Node Attribute Selection for Decision Trees Using ID3
4. Solving Regression & Classification using Decision Trees - Cart
5. Using Weka Tool for SVM Classification for Chosen Domain Application
6. Data & Text Clustering Using K-Means Algorithm
7. Dimensionality Reduction Algorithms in Image Processing Applications
8. Naive Bayes Classifier
9. Random Forest

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Understand and apply unsupervised learning algorithms for clustering.
2. Implement machine learning algorithms related to numeric data
3. Learn the application of supervised machine learning algorithms
4. Use dimensionality reduction algorithms for image processing applications
5. Use fundamental regression algorithms for solving real-world data
6. Decide to apply a specific type of ML algorithm for real-world problems

CA5001 BLOCKCHAIN TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To decompose a blockchain system’s fundamental components, how they fit together and examine a decentralization using blockchain.
- To explain how Cryptocurrency works, from when a transaction is created to when it is considered part of the blockchain.
- To explain the components of Ethereum and programming languages for Ethereum.
- To study the basics Hyperledger and Web3.
- To provide details of alternative blockchain and blockchain projects in different perspective.

UNIT I INTRODUCTION TO BLOCKCHAIN 9

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

Suggested Activities:

- External learning - Programming to create your own Blockchain.
- Flipped classroom on studying Blockchain security issues.

Suggested Evaluation Methods:

- Practical assessment to be conducted to evaluate the program for creating Blockchain.

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

Suggested Activities:

- External learning - Creating the Wallets.
- Flipped classroom on showing the tracking process of transactions in Cryptocurrency.

Suggested Evaluation Methods:

- Assignment to be given on cryptocurrency failures.

UNIT III ETHEREUM 9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

Suggested Activities:

- External learning - Exploring Ethereum tools like Ganache and GO.
- Practical - Setup the Ethereum development environment.
- Practical - Develop smart contract on private Blockchain.

Suggested Evaluation Methods:

- Evaluation of developed smart contract on private Blockchain

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.

Suggested Activities:

- Practical - Creating and deploying a business network on Hyperledger Composer Playground.
- Practical - Implementation of business network in Blockchain using hyperledger Fabric.

Suggested Evaluation Methods:

- Evaluation of developed business network on hyperledger fabric.

UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

Suggested Activities:

- External learning - Blockchain using multichain.
- Assignments on Blockchain frameworks and business applications.

Suggested Evaluation Methods:

- Practical assessment of developing Blockchain based solution using Multichain for banking system.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand the technology components of Blockchain and how it works behind – the scenes.
2. Be aware of different approaches to developing decentralized applications.
3. Understand the Bitcoin and its limitations by comparing with other alternative coins.

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4. Establish deep understanding of the Ethereum model, its consensus model and code execution.
5. Understand the architectural components of a Hyperledger and its development framework.
6. Aware of the Alternative blockchains and emerging trends in blockchain.

REFERENCES:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, 2017.
3. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly, 2014.
4. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing, 2016.
5. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
6. Alex Leverington, “Ethereum Programming” Packt Publishing, 2017.

CA5002 ETHICAL HACKING L T P C
3 0 0 3

OBJECTIVES:

- To explore the concepts of security testing and the knowledge required to protect against the hacker and attackers.
- To understand reconnaissance and the publicly available tools used to gather information on potential targets.
- To discover the scanning techniques used to identify network systems open ports.
- To identify network system vulnerabilities and confirm their exploitability.
- To explore techniques for identifying web application vulnerabilities and attacks.

UNIT I INTRODUCTION TO HACKING 9

Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement – Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports.

Suggested Activities:

- In-class activity to understand the penetration testing methodologies.
- Practical - Use security tools in Kali Linux to assess the vulnerabilities.
- Prepare Vulnerability Assessment summary reports.

Suggested Evaluation Methods:

- Assignment on categories of penetration testing and vulnerability summary reports .
- Quiz on penetration testing methodologies, OSSTMM and OWASP.

UNIT II INFORMATION GATHERING AND SCANNING 9

Information Gathering Techniques – Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute – ICMP Traceroute – TCP Traceroute – Usage – UDP Traceroute – Enumerating and Fingerprinting the Webservers – Google Hacking – DNS Enumeration – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.

Suggested Activities:

- Explain different ways to gather the information of a system in the network.
- Demonstrate the network command tools to identify the system.
- Understand the network protocols and port scanning techniques using Kali linux.

Suggested Evaluation Methods:

- Assignment problems on information gathering and traceroute of ICMP, DNS and SNMP.
- Quizzes on enumeration, port scanning techniques and firewall/IDS evading techniques.

UNIT III NETWORK ATTACKS 9

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – Promiscuous versus Nonpromiscuous Mode – MITM Attacks – ARP Attacks – Denial of Service Attacks –Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic –DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.

Suggested Activities:

- Familiarizing with different types of attacks such as sniffing, spoofing etc.
- Demonstrating the MITM attack using ARP Poisoning using Kali Linux.
- Teaching with case studies: SSL Stripping, SQL Injection, Brute Force attacks.

Suggested Evaluation Methods:

- Assignment on denial of service (DoS) attack and hijacking session with MITM attack.
- Quizzes on SSL stripping, ARP spoofing and weak authentication.

UNIT IV EXPLOITATION 9

Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E–Mails with Malicious Attachments – Creating a Custom Executable – Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Acquiring Situation Awareness – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials

Suggested Activities:

- Case studies: Understand the Metasploit and Exploitations.
- Demonstrating email with malicious attachment and cracking the hashes.
- Practical - Implementing hashing algorithms and cracking the hashes.

Suggested Evaluation Methods:

- Assignments on social engineering toolkit and browser exploitation.
- Quizzes on reconnaissance with Metasploit and client–side exploitation methods.

UNIT V WIRELESS AND WEB HACKING 9

Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Types of Authentication – Log-In Protection Mechanisms – Captcha Validation Flaw – Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability – Automating It with Burp Suite – Session Attacks – SQL Injection Attacks – XSS (Cross-Site Scripting) – Types of Cross-Site Scripting – Cross-Site Request Forgery (CSRF) – SSRF Attacks.

Suggested Activities:

- Cracking the WEP and WPA/WPA2 passphrase using Cracking tool in Kali Linux.
- Design a web application with different authentication mechanism.
- Understand the protection mechanism to prevent against various server attacks.

Suggested Evaluation Methods:

- Assignment on evil twin attack and denial of service attack on access point in WLAN.
- Quizzes on types of authentication and vulnerabilities in a web application.

TOTAL: 45 PERIODS

Attested

OUTCOMES:

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

1. Use the various security tools to assess the computing system.

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2. Predict the vulnerabilities across any computing system using penetration testing.
3. Identify prediction mechanism to prevent any kind of attacks.
4. Protect the system from malicious software and worms.
5. Evaluate the wireless network flaws and able to apply security patches .
6. Analyze the risk and support the organization for effective security measures.

REFERENCES:

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.
2. Kevin Beaver, “Ethical Hacking for Dummies”, Sixth Edition, Wiley, 2018.
3. Jon Erickson , “Hacking: The Art of Exploitation”, Second Edition, Rogunix, 2007.

CA5003 BIG DATA WITH R L T P C
3 0 0 3

OBJECTIVES:

- To introduce big data, its evolution and applications.
- To familiarize the students with fundamental data analysis using R.
- To expose the students to different big data frameworks with R.
- To learn about integrating R and Hadoop.
- To learn about machine learning methods in RStudio.

UNIT I INTRODUCTION TO R 9

Introduction to R – Installing R and RStudio – Understanding the features of R Language – RStudio’s user interface – RStudio Server – R basic objects – Importing data from different formats using RStudio IDE, built – in functions and readr package – Reading and writing from excel, native data files, single object – Loading built – in datasets.

Suggested Activities:

- Survey of R features for data analytics.
- Case studies on R equivalent features in other open source analytical tools.
- Remembering activities for R commands.

Suggested Evaluation Methods:

- Programming assignments to basic R objects and operations.
- Assignments on classification and summarization of various commands in R.
- Quiz basic R commands.

UNIT II DATA ANALYTICS USING R 9

Data aggregations and contingency tables in R – Hypothesis Testing: Independent t – test, ANOVA – Tests of Relationships: Pearson’s Correlation, Multiple Regression – Data visualization packages in R.

Suggested Activities:

- Exercises on aggregate functions in R.
- Solving numerical problems in sampling, hypothesis testing – t – test and ANOVA.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Student assignment on problem formation, hypothesis testing in R.
- Simple Lab tasks to apply visualization commands on standard data sets.
- Lab quiz on visualization commands in R.

UNIT III R WITH NOSQL DATABASES 9

Introduction to NoSQL Databases – Sharding in MongoDB – MongoDB with R: MongoDB data models – Installing MongoDB with R – Accessing Big Data using MongoDB with R: Importing Data – using rmongodb, RMongo and mongolite Package.

Suggested Activities:

- Programming Exercises on importing different types of data using R.
- Installation and configuring MongoDB.
- Trialing data importing using mongolite package.

Suggested Evaluation Methods:

- Student assignment exploring different data types in R.

UNIT IV INTEGRATING R AND HADOOP 9

Introduction to RHadoop – Architecture of RHadoop – Installing RHadoop – RHadoop word count example – understanding hdfs and rmr package – importing data to HDFS and HBase – Reading and querying HBase using rhbase package – Hadoop streaming with R – executing Hadoop streaming job from R/RStudio.

Suggested Activities:

- Demonstration of Installation and configuration of Hadoop and R in Hadoop.
- Demonstration on simple sorting, searching application in Hadoop.

Suggested Evaluation Methods:

- Mini projects about word search from large text files in Hadoop.

UNIT V MODELING WITH R 9

Machine Learning methods in R – Naïve Bayes with H2O on Hadoop with R: Running an H2O instance – Reading and exploring the data in H2O – Naïve Bayes on H2O with R – Neural Networks with H2O on Hadoop with R.

Suggested Activities:

- Demonstration of Bayesian, neural network based data modeling using small datasets.
- Demonstration on programs to read, write and visualize data in H2O.
- Survey of other data modeling features in H2O.

Suggested Evaluation Methods:

- Mini projects involving data handling using H2O.
- Lab exercises to read different data from heterogeneous sources into H2O.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Write and execute simple to complex analytical programs in R.
2. Demonstrate fundamental analytical packages in R.
3. Create tables and query from MongoDB.
4. Implement, configure and work with big data platform.
5. Install Hadoop and write Map Reduce Programs.
6. Apply data modeling using H2O packages.

REFERENCES:

1. Simon Walkowiak, “Big Data Analytics with R”, Packt Publishing, 2016.
2. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
3. Seema Acharya, “Data Analytics using R”, McGraw-Hill, 2018.
4. Kun Ren, “Learning R Programming”, Packt Publishing.
5. Hadley Wickham and Garett Grolemund, “R for Data Science: Import, Tidy, Transform, Visualize, and Model Data”, O’Reily, 2017.
6. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2014.

Interested

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CA5007 **E-LEARNING TECHNIQUES** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn the various E-learning approaches and components.
- To understand the types of design models of E-Learning.
- To explore the models for E-learning courseware development.
- To learn about E-learning authoring tools.
- To know about evaluation and management of E-learning solutions.

UNIT I INTRODUCTION **9**

Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Basics of Design Thinking.

Suggested Activities:

- External learning - E-learning approaches and components.
- Discussion on blended learning.

Suggested Evaluation Methods:

- Assignment on E-learning approaches and components.
- Quizzes on blended learning.

UNIT II DESIGNING E-LEARNING COURSE CONTENT **9**

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

Suggested Activities:

- Discussion forum on design models.
- External learning on E-Learning instructional methods.

Suggested Evaluation Methods:

- Assignment on design models of E-learning.
- Quiz on E-Learning instructional methods.

UNIT III CREATING INTERACTIVE CONTENT **9**

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

Suggested Activities:

- Discussion on creation of story boards.
- Discussion on courseware creation.
- External learning - Types of authoring tools.

Suggested Evaluation Methods:

- Demonstration of Story Boards creation with Moodle.
- Demonstration of creation of a complete courseware with Moodle.
- Quiz on authoring tools.

UNIT IV LEARNING PLATFORMS **9**

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

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Suggested Activities:

- Discussion on LMS categories for E-learning.
- External learning - Functional areas of E-learning.

Suggested Evaluation Methods:

- Assignment on proprietary and open source LMS.
- Quiz on LMS solutions.

UNIT V COURSE DELIVERY AND EVALUATION 9

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

Suggested Activities:

- Discussion on planning and documentation.
- External learning - Evaluation and delivery methods.

Suggested Evaluation Methods:

- Assignment on planning and documentation.
- Quiz on evaluation and delivery methods.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Distinguish the phases of activities in the models of E-learning.
2. Identify appropriate instructional methods and delivery strategies.
3. Choose appropriate E-learning authoring tools.
4. Create interactive E-Learning courseware.
5. Evaluate the E-learning courseware.
6. Manage the E-learning courseware.

REFERENCES:

1. Clark, R. C. and Mayer, R. E, “eLearning and the Science of Instruction”, Third Edition, John Wiley, 2016.
2. Means, B., Toyama, Y., and Murphy, R, “Evaluation of Evidence – Based Practices in Online Learning: A Meta – Analysis and Review of Online Learning Studies”, Centre for Learning Technologies, 2010.
3. Crews, T. B., Sheth, S. N., and Horne, T. M, “Understanding the Learning Personalities of Successful Online Students”, Educause Review, 2014.
4. Johnny Schneider, “Understanding Design Thinking, Lean and Agile”, O’Riley Media, 2011.
5. Madhuri Dubey, “Effective E – learning Design, Development and Delivery”, University Press, 2011.

CA5008 SOFTWARE TESTING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basics and necessity of software testing.
- To provide various testing techniques along with concepts of software bugs and its impact.
- To develop and validate a test plan.
- To build a testing team required.
- To understand the need for and challenges in test automation and to develop testing scripts.

UNIT I TESTING PRINCIPLES AND AXIOMS 9

Testing as a Process – Testing Axioms –Software Testing Principles – Origins and Cost of Defects – Defect Classes and Examples – Developer/Tester Support of Developing a Defect Repository –

Defect Prevention Strategies.

Suggested Activities:

- Flipped classroom on testing axioms.
- Identify and analyze syntax error, semantic error, bug and defect for programs.

Suggested Evaluation Methods:

- Quiz and discussion on testing axioms.
- Identifying fallacies in requirements specification.
- Identify the various types of errors, bugs and defects for a case study.

UNIT II BLACK BOX, WHITE BOX TESTING AND TEST ADEQUACY 9

Test Case Design Strategies – Black Box Approach – Boundary Value Analysis – Equivalence Class Partitioning – State-Based Testing – User Documentation Testing – White Box Approach – Static Testing vs. Structural Testing – Code Functional Testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Cyclomatic Complexity – Test Adequacy Criteria.

Suggested Activities:

- Flipped classroom on test adequacy criteria.
- External learning - Exploring white box testing tools like veracode, eclemma, rcunit, cppunit, Junit, JSUnitetc.
- Analyzing the cyclomatic complexity of code segments.

Suggested Evaluation Methods:

- Quiz and discussion on cyclomatic complexity.
- Assignments on white box testing tools like Selenium, Appium, Robotium and carrying out simple BBT and WBT using tools.
- Solving problems related to cyclomatic complexity.

UNIT III LEVELS OF TESTING 9

Unit Test – Planning – Designing the Unit Test Process – Running the Unit Tests and Recording Results – Integration Test Planning – Scenario Testing – Defect Bash Elimination System Testing – Acceptance Testing – Performance Testing – Regression Testing – Internationalization Testing – Ad-Hoc Testing – Alpha, Beta Tests.

Suggested Activities:

- External learning - Exploring the integration testing tools for various programming languages – VectorCAST/C++, CITRUS (Java), FitNesse (open source), Rational test integration tester, Protractor (Angular, Angular JS), Jasmine (JavaScript), Spock (Java) and the regression testing tools – Sahi Pro, Watir, IBM Rational Regression Tester, TestDrive etc.
- Flipped classroom on alpha and beta testing.
- Analyzing various levels of testing required for a software product.

Suggested Evaluation Methods:

- Assignments on integration testing tools and regression testing tools.
- Quiz and discussion on alpha and beta testing.
- Identifying and performing various levels of testing for a case study.

UNIT IV TEST MANAGEMENT 9

Organization Structures For Testing Teams – Testing Services – Test Planning Attachments – Locating Test Items – Test Management – Reporting Test Results – The Role of Three Groups in Test Planning and Policy Development – Introducing the Test Specialist – Skills Needed by a Test Specialist – Building a Testing Group.

Suggested Activities:

- Flipped classroom on reporting test results.
- External learning - Exploring the organization structures and organizational behaviour in the context of software testing.

- Analyzing how to build testing groups for various types of projects and organizations.

Suggested Evaluation Methods:

- Quiz and discussion on reporting test results.
- Finding out the organization structure and organizational behaviour for given case studies.
- Building test groups for given case studies.

UNIT V TEST AUTOMATION 9

Software Test Automation – Skill Needed for Automation – Scope of Automation – Design and Architecture for Automation – Requirements for a Test Tool – Challenges in Automation – Test Metrics and Measurements – Project, Progress and Productivity Metrics – Maintenance of Documents During Testing.

Suggested Activities:

- Flipped classroom on test metrics and measurements.
- External learning - Exploring the risks involved in automated testing and exploring the ways to improve your testing skills apart from using testing tools.
- Practical - Install and learn popular software testing tools like Selenium, Win Runner, LoadRunner, Performance Tester etc.
- Learning to write test scripts.

Suggested Evaluation Methods:

- Quiz and discussion on test metrics and measurements.
- Assignments on evaluating the risks involved in automated testing for given case studies.
- Assignments on writing test scripts to carry out various types of testing in test automation tools.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Obtain an insight to software testing.
2. Apply both black box testing and white box testing.
3. Understand and apply multiple levels of testing.
4. Understand the role of a tester as an individual and as a team member.
5. Apply software testing for large projects using automated testing tools.
6. Maintain documentation on testing.

REFERENCES:

1. Paul C. Jorgensen, “Software Testing: A Craftsman's Approach”, Fourth Edition, CRC Press, 2013.
2. Dorothy Graham, Mark Fewster, “Experiences of Test Automation: Case Studies of Software Test Automation”, Pearson Education, 2012.
3. Glenford J. Myers, Tom Badgett, Corey Sandler, “The Art of Software Testing”, Third edition, John Wiley & Sons publication, 2012.
4. Srinivasan Desikan, Gopalaswamy Ramesh, “Software Testing - Principles and Practices”, Pearson Education, 2009.
5. Boris Beizer, “Software testing techniques”, Dream Tech Press, 2009.
6. Mauro Pezze, Michal Young, “Software Testing and Analysis Process Principles and Techniques”, Wiley India, 2008.
7. Ali Mili and Fairouz Chier, “Software Testing: Concepts and Operations”, Wiley, 2015.

CA5009 DEEP LEARNING TECHNIQUES AND APPLICATIONS LT P C
3 0 0 3

Attested

OBJECTIVES:

- To understand the basic ideas and principles of neural networks.
- To understand the basic concepts of deep learning.

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- To familiarize with image processing facilities like TensorFlow and Keras.
- To appreciate the use of deep learning applications.
- To understand and implement deep learning architectures.

UNIT I BASICS OF NEURAL NETWORKS 9

Basic Concept of Neurons – Perceptron Algorithm – Feed Forward and Backpropagation Networks.

Suggested Activities:

- Discussion of role of neural networks.
- External learning - Boltzmann Machine, perceptron.
- Practical - Implementation of simple neural network in Matlab

SUGGESTED EVALUATION METHODS

- Tutorials on perceptron.
- Assignments on backpropagation networks.
- Quizzes on neural networks.

UNIT II INTRODUCTION TO DEEP LEARNING 9

Deep Feed-Forward Neural Networks – Gradient Descent – Back-Propagation and Other Differentiation Algorithms – Vanishing Gradient Problem – Mitigation – Rectified Linear Unit (ReLU) – Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training –Nestors Accelerated Gradient Descent – Regularization for Deep Learning – Dropout – Adversial Training – Optimization for Training Deep Models.

Suggested Activities:

- Discussion of role of Gradient Descent in deep learning.
- External learning - Feature extraction and feature learning.
- Practical - Implementation of TensorFlow and Keras applications.

Suggested Evaluation Methods:

- Tutorials on gradient descent and regularization
- Assignments on optimization.
- Quizzes on deep learning regularization and optimization.

UNIT III CONVOLUTIONAL NEURAL NETWORKS 9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning – Recurrent and Recursive Nets – Recurrent Neural Networks – Deep Recurrent Networks – Recursive Neural Networks – Applications.

Suggested Activities:

- Discussion of role of convolutional networks in Machine Learning.
- External learning - Concept of convolution and need for Pooling.

Suggested Evaluation Methods:

- Tutorials on image classification and recurrent nets.
- Assignments on image classification performances.
- Quizzes on convolutional neural networks.

UNIT IV ADDITIONAL DEEP LEARNING ARCHITECTURES 9

Long Short Term Memory (LSTM) Networks – Sequence Prediction – Gated Recurrent – Encoder/Decoder Architectures – Autoencoders – Standard – Sparse – Denoising – Contractive – Variational Autoencoders – Applications of Autoencoders – Representation Learning – Deep generative Models – Deep Belief Networks – Deep Generative Networks – Generative Schemes – Evaluating Generative Models.

Suggested Activities:

- Discussion of role of Deep Learning architectures.
- External learning - Compression of features using Auto-encoders.
- Practical - Implementation of simple deep learning architectures.

Suggested Evaluation Methods:

- Tutorials on LSTM and Autoencoders.
- Assignments on deep generative models, Deep Belief Networks.
- Quizzes on deep learning architectures.

UNIT V APPLICATIONS OF DEEP LEARNING 9

Images segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative adversarial networks – Video to Text with LSTM models – Attention models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

Suggested Activities:

- Discussion of role of deep learning in image and NLP applications.
- External learning - NLP concepts.
- Practical - Implementation of simple deep learning for object detection and recognition in images.

Suggested Evaluation Methods:

- Tutorials on images segmentation.
- Assignments on parsing and sentiment analysis.
- Quizzes on deep learning applications

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the role of deep learning in machine learning applications.
- Get familiar with the use of TensorFlow and Keras in deep learning applications.
- Design and implement deep learning applications.
- Critically analyze different deep learning models in image related projects.
- Design and implement convolutional neural networks.
- Know about applications of deep learning in NLP and image processing.

REFERENCES:

1. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.
4. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
6. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

CA5010 GAME PROGRAMMING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of game engine.
- To survey the gaming development environment and toolkits.
- To learn and develop simple games using Pygame environment.

UNIT I 3D GRAPHICS FOR GAME PROGRAMMING 9

Game – Definition – Genres of Games, Basics of 2D and 3D Graphics, Game Objects Design – 2D and 3D Transformations – Projections – Colour Models – Illumination and Shader Models – Animation – Controller based Animation.

Attested

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Suggested Activities:

- Discussion about computer and video games origin and history.
- Discussion of graphics objects, Open source language for Game development like Pygame and Processing.py - a Language for Creative Arts.
- External learning - Practical problems in translation, scaling, zooming and rotation of 2D and 3D objects.
- Practical - Installation of Pygame and Pygame Zero and Implementation of colour models and shading models in Python.

Suggested Evaluation Methods:

- Tutorial - 2D and 3D transformations.
- Evaluation of programming exercises for Python implementation.
- Assignments on image projections and colour models.
- Quizzes on 2D and 3D game object transforms.

UNIT II GAME DESIGN PRINCIPLES 9

Character Development, Storyboard Development for Gaming – Script Design – Script Narration –Game Balancing –Core Mechanics – Principles of Level Design – Proposals – Writing for Pre-production, Production and Post-Production.

Suggested Activities:

- Flipped classroom on animation.
- Creation of game script in natural language and story creation.
- External learning - Practical problems in game level design.
- Practical - Producing game level design document, detailed document.

Suggested Evaluation Methods:

- Tutorial - Script writing.
- Assignments on game proposal writing.
- Quizzes on game design document.

UNIT III GAME ENGINE DESIGN 9

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine – Collision Detection – Game Logic – Game AI – Path Finding.

Suggested Activities:

- Flipped classroom on rendering.
- External learning - Image rendering and animation.
- Practical - Implementation of simple animations in Pygame and Processing.py

Suggested Evaluation Methods:

- Tutorial problems in collision detection.
- Assignments on game AI and path finding.
- Quizzes on rendering.

UNIT IV OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 9

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity –Single player and Multi-Player games.

Suggested Activities:

- Flipped classroom on gaming environments.
- External learning on Unity Game Engine.
- Practical - Installation of Unity and scripts.
- Practical - Pygame routines for character rendering, transformations and sound processing.

Suggested Evaluation Methods:

- Tutorial - Collision detection.
- Assignments on Unity Game Engine.

Attested

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- Quizzes of all topics related to Unity and Pygame.

UNIT V GAME DEVELOPMENT USING PYGAME 9

Developing 2D and3D Interactive Games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating Music and Sound – Asset Creations – Game Physics Algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based Games – Overview of Puzzle Games.

Suggested Activities:

- External learning - Writing Unity scripts and assets.
- Practical - Implementation of simple games.

Suggested Evaluation Methods:

- Tutorial problems in 2D and 3D graphics programming.
- Programming problems like asset creation
- Quizzes on game development in Pygame.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Have knowledge on the concepts of 2D and 3D graphics.
2. Know about games and their genres with their origin and history.
3. Prepare game design documents.
4. Understand the implementation of gaming engines.
5. Survey gaming environments and frameworks.
6. Implement a simple game in Pygame.

REFERENCES:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison-Wesley Professional, 2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress Publishers, 2007.
3. Paul Craven, “Python Arcade games”, Apress Publishers, 2016.
4. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press, 2006.
5. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.

CA5011 MULTIMEDIA TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To enrich student learning in multimedia systems.
- To train the students to acquire knowledge in multimedia related technologies.
- To acquire knowledge about multimedia techniques to enhance quality of service.
- To acquire knowledge in the development of multimedia systems.
- To learn about the multimedia elements in a comprehensive way.

UNIT I INTRODUCTION TO MULTIMEDIA ELEMENTS 9

Multimedia – Medium – Properties of a Multimedia system – Traditional Data Stream Characteristics – Data Stream Characteristics of Continuous Media – Basic Sound Concepts – Speech – Images and Graphics – Computer Image Processing – Video and Animation – Computer Based Animation.

Suggested Activities:

- Flipped classroom on multimedia concepts.
- Practical - Creating and editing visual elements using tools like Audacity, Fontographer, Blender, Photoshop and flash.

Attested

Suggested Evaluation Methods:

- Demonstration of the practical exercise.

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- Assignments on creativity and visual appearance.
- Quizzes on sound, speech and image-related concepts.

UNIT II MULTIMEDIA COMPRESSION 9

Storage Space – Coding Requirements – Hybrid Coding – JPEG: Image Preparation, Lossy Mode, Lossless Mode, Hierarchical Mode – H.261 – MPEG: Video Encoding, Audio Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21 – DVI – Audio Encoding.

Suggested Activities:

- Flipped classroom on different compression techniques.
- Practical - Adobe Premier Pro for Digital Video Concepts.
- External learning - Adobe aftereffects, Adobe Media Encoder and Adobe Audition.

Suggested Evaluation Methods:

- Demonstration, finalization and output of the practical learning.
- Quizzes on MPEG and audio encoding.

UNIT III MULTIMEDIA ARCHITECTURES 9

User Interfaces – OS Multimedia Support – Multimedia Extensions – Hardware Support – Distributed Multimedia Applications – Real Time Protocols – Play Back Architectures – Synchronization – Document and Document Architecture – Hypermedia Concepts – Hypermedia Design – Digital Copyrights – Digital Library – Multimedia Archives.

Suggested Activities:

- Flipped classroom on concepts of Multimedia hardware architectures.
- External learning - Digital repositories.

Suggested Evaluation Methods:

- Tutorial - Document architecture.
- Quizzes on hypermedia.

UNIT IV MULTIMEDIA OPERATING SYSTEM AND DATABASES 9

Real Time – Resource Management – Process Management – File Systems – Interprocess Communication and Synchronization – Memory Management – Device Management – Characteristics of MDBMS – Data Analysis – Data Structures – Operations on Data – Integration in a Database Model.

Suggested Activities:

- Flipped classroom on multimedia database and indexing structures.
- External learning - Data structures for storing multimedia data.

Suggested Evaluation Methods:

- Quizzes on various concepts of multimedia databases.
- Assignments on various operations on data

UNIT V MULTIMEDIA COMMUNICATION & APPLICATIONS 9

Tele Services – Implementation of Conversational Services, Messaging Services, Retrieval Services, Tele Action Services, Tele Operation Services – Media Consumption – Media Entertainment – Virtual Reality – Interactive Audio – Interactive Video – Games.

Suggested Activities:

- Practical - Designing user interfaces and developing simple games.
- External learning - Mixed reality.

Suggested Evaluation Methods:

- Demonstration of developed applications.
- Quizzes on virtual reality and augmented reality.

Attested

TOTAL: 45 PERIODS

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OUTCOMES:

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

1. Handle the multimedia elements effectively.
2. Encode and decode the multimedia elements.
3. Understand the underlying multimedia computing architectures used for media development.
4. Develop effective strategies to deliver quality-of-experience in multimedia applications.
5. Design and implement algorithms and techniques related to multimedia objects.
6. Design and develop multimedia applications in various domains.

REFERENCES:

1. Ralf Steinmetz, Klara Nahrstedt, "Multimedia Computing, Communications, and Applications", Pearson India, 2009.
2. Ranjan Parekh, "Principles of Multimedia", Second Edition, McGraw Hill Education, 2017.
3. Ralf Steinmetz, Klara Nahrstedt, "Multimedia Systems", Springer, 2004.
4. Tay Vaughan, "Multimedia: Making it Work", McGraw – Hill Education, Ninth Edition, 2014.
5. Mark S Drew, Zee Nian Li, "Fundamentals of multimedia", Prentice Hall, 2006.
6. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh, Richard L. "Baker Digital Compression for Multimedia: Principles and Standards", Elsevier, 2006.

CA5012 DATA VISUALIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of data visualization.
- To know the working principles of various information visualization tools.
- To acquire knowledge about the issues in data representation.
- To visualize the complex engineering design.
- To gain skill in designing real time interactive information visualization system.

UNIT I INTRODUCTION 9

Introduction – Visualization Stages – Computational Support – Issues – Different Types of Tasks – Data representation – Limitation: Display Space – Rendering Time – Navigation Links.

Suggested Activities:

- Blended Learning - Displaying different types visualization images.
- Flipped classroom on the task of representing information.
- External learning - Practical problems related to acquiring data.
- Practical - Representing various varieties of data.

Suggested Evaluation Methods:

- Tutorial - Different data visualizing images.
- Assignment on different data acquiring methods.
- Quizzes on various issues and solutions in different visualization applications.
- Demonstration of the techniques used for data representation.

UNIT II DATA REPRESENTATION 9

Human Factors – Foundation for a Science of Data Visualization – Optics – Optimal Display – Overview about Lightness, Brightness, Contrast, Constancy, Color – Visual Attention that Pops Out – Types of Data – Data Complexity – Encoding of Values – Encoding of Relation – Relation and Connection – Alternative Canvasses.

Suggested Activities:

- Blended Learning - Human visual and auditory system.
- Flipped classroom on color formats.
- Practical - Implementation of the interactive forms.
- External learning - Survey on different human computer interaction and types of user interface.

Attested

Suggested Evaluation Methods:

- Assignments on human visual and auditory system.

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- Quizzes on color format.
- Assessments design and creativity.
- Assignments on various human computer interaction user interface.

UNIT III DATA PRESENTATION 9

Human Vision – Space Limitation – Time Limitations – Design – Exploration of Complex Information Space – Figure Caption in Visual Interface – Visual Objects and Data Objects – Space Perception and Data in Space – Images, Narrative and Gestures for Explanation.

Suggested Activities:

- Blended Learning - Drawing charts for display.
- Flipped classroom on various presentation techniques.
- External learning - Different font and font styles, symbols and gesture representation.
- Practical - Implementation of these presentations through interfaces in computers.

Suggested Evaluation Methods:

- Assignment on chart preparation.
- Tutorial - Various presentation techniques.
- Assignment on gesture presentation.
- Demonstration of the designed interface layout.

UNIT IV INTERACTION 9

Norman's Action Cycle – Interacting with Visualization – Interaction for Information Visualization – Interaction for Navigation – Interaction with Models – Interacting with Visualization – Interactive 3D Illustrations with Images and Text.

Suggested Activities:

- Flipped classroom on various interacting Techniques.
- Practical - Implementations of interactive interfaces.
- External learning - Interaction facilities and high level support for animation design.

Suggested Evaluation Methods:

- Tutorial - Interaction models.
- Demonstration of the based on interactivity.
- Assignment on animation design.

UNIT V CURRENT TRENDS 9

Design – Virtual Reality: Interactive Medical Application – Tactile Maps for visually challenged People – Animation Design for Simulation – Integrating Spatial and Nonspatial Data – Innovating the Interaction.

Suggested Activities:

- Practical - Mini project for designing and implementing innovative interfaces.
- Flipped classroom on the implementation of virtual reality environment.

Suggested Evaluation Methods:

- Demonstration of the mini project.
- Tutorial - Virtual reality application.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Apply mathematics and basic science knowledge for designing information visualizing system.
2. Collect data ethically and solve engineering problem in visualizing the information.
3. Implement algorithms and techniques for interactive information visualization.
4. Conduct experiments by applying various modern visualization tool and solve the space layout problem.
5. Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams.
6. Develop a cost effective and a scalable information visualization system.

REFERENCES:

1. Colin Ware, “Information Visualization Perception for Design” Third Edition, Morgan Kaufmann Publishers, 2012.
2. Robert Spence, “Information Visualization An Introduction”, Third Edition, Pearson Education, 2014.
3. Benjamin B. Bederson and Ben Shneiderman, “The Craft of Information Visualization” Morgan Kaufmann Publishers, 2003.
4. Thomas strothotte, “Computational Visualization: Graphics, Abstraction and Interactivity”, Springer, 1998.
5. Matthew O.Ward, George Grinstein, Daniel Keim, “Interactive Data Visualization: Foundation, Techniques and Applications”, Second Edition, A.K.Peters/ CRC Press, 2015.
6. Robert Spence, “Information Visualization Design for Interaction”, Second Edition, Pearson Education, 2006.
7. Joerg Osarek, “Virtual Reality Analytics”, Gordon’s Arcade, 2016.

CA5014 C# AND .NET PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To learn the technologies of the .NET framework.
- To cover all segments of programming in C# starting from the language basis, followed by the object oriented programming concepts.
- To update and enhance skills in writing Windows applications, ADO.NET and ASP .NET.
- To introduce advanced topics namely data connectivity, WPF, WCF and WPF with C# and .NET 4.5.
- To implement mobile applications using .Net Compact Framework.

UNIT I C# LANGUAGE BASICS 9

.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Structs – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers- Assemblies – Shared Assemblies – CLR Hosting – Appdomains.

Suggested Activities:

- Installation of .Net framework and experimenting simple C# programs using IDE.
- Flipped Classroom on CLR internals.
- Creation of shared assemblies.

Suggested Evaluation Methods:

- Quiz on CLR internals.
- Tutorials on C# programming fundamentals.

UNIT II C# ADVANCED FEATURES 9

Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

Suggested Activities:

- Implementing delegates and handling events.
- Practical - Generic collections, memory management and exception handling.

Suggested Evaluation Methods:

- Demonstration of implemented programs.
- Tutorial case studies on advanced C# features.

UNIT III BASE CLASS LIBRARIES AND DATA MANIPULATION 9

Diagnostics Tasks – Threads and Synchronization – Manipulating XML – SAX and DOM –

Manipulating files and the Registry – Transactions – Data access with ADO.NET: Introduction, LINQ to Entities and the ADO.NET Entity Framework, Querying a Database with LINQ – Creating the ADO.NET Entity Data Model Class Library, Creating a Windows Forms Project – Data Bindings Between Controls and the Entity Data Model – Dynamically Binding Query Results.

Suggested Activities:

- Implementation of Threads and Synchronization based application.
- Practical - Programs on XML and operations using parsers.
- Application development with ADO.NET.

Suggested Evaluation Methods:

- Tutorials on SAX and DOM parsers.
- Presentation of ADO.NET based application.

UNIT IV WINDOW AND WEB BASED APPLICATIONS 9

Window Based Applications – Core ASP.NET – ASP.NET Web Forms – Server Controls, Data Binding – ASP.NET State Management, Tracing, Caching, Error Handling, Security, Deployment, User and Custom Controls – Windows Communication Foundation (WCF) – Introduction to Web Services.

Suggested Activities:

- Practical - Programs using ASP.NET and State management controls.
- Flipped classroom on web services with .NET.
- Tutorials on WCF framework.

Suggested Evaluation Methods:

- Quizzes.
- Demonstration of the implemented programs on ASP.NET web services.

UNIT V .NET COMPACT FRAMEWORK 9

Reflection – .Net Remoting-.Net Security – Localization – Peer-to-Peer Networking – Building P2P Applications – .Net Compact Framework – Compact Edition DataStores – Testing and Debugging – Optimizing performance – Packaging and Deployment.

Suggested Activities:

- Demonstration of programs using .Net Remoting and .net Security APIs.
- Demonstration of programs using .Net compact framework.

Suggested Evaluation Methods:

- Presentation of .NET compact framework application.
- Evaluation of programs using .Net remoting and .Net security APIs.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand the difference between .NET and Java framework.
2. Work with the basic and advanced features of C# language.
3. Create applications using various data providers.
4. Create web application using ASP.NET.
5. Create mobile application using .NET compact framework.
6. Integrate all the features of C# language and build complex web applications in .NET framework.

REFERENCES:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, “Professional C# and .NET 4.5”, Wiley, 2012.
2. Andrew Troelsen, “Pro C# 5.0 and the .NET 4.5 Framework”, Apress publication, 2012.
3. Ian Gariffiths, Mathew Adams, Jesse Liberty, “Programming C# 4.0”, O‘Reilly, Sixth Edition,

2010.
4. Andy Wigley, Daniel Moth, “Peter Foot, —Mobile Development Handbook”, Microsoft Press, 2011.
5. Herbert Schildt, “C# The Complete Reference”, Tata McGraw Hill, 2004.

CA5015 SERVICE ORIENTED ARCHITECTURES L T P C
3 0 0 3

OBJECTIVES:

- To analyze various software architectures and understand the basic principles of service orientation.
- To learn the service oriented architecture and micro services architecture.
- To understand the technologies associated with SOA.
- To analyze and implement web service based applications and realize SOA.
- To learn micro services related frameworks and develop applications.

UNIT I SOFTWARE ENGINEERING PRACTICES 9

Software Engineering Principles – SDLC – Agile Development Methodologies – Emergence of Devops Architecture – Need For Software Architecture – Types of IT Architecture – Pattern and Style – Architecting Process for Software Applications – High Level Architecture – Solution Architecture – Software Platforms – Enterprise Applications – Custom Software Applications – Cloud Computing Platforms.

Suggested Activities:

- Sample application for each type of architecture.
- Study of popular enterprise applications.
- Cloud computing platforms comparison.
- DevOPs solution fundamentals.

Suggested Evaluation Methods:

- Quiz on various concepts.
- Simple development based on the solutions and study.

UNIT II SOA AND MSA BASICS 9

SOA and MSA – Basics – Evolution of SOA & MSA – Drivers for SOA – Dimensions, Standards and Guidelines for SOA – Emergence of MSA – Enterprise-wide SOA – Strawman and SOA Reference Architecture – OOAD Process & SOAD Process – Service Oriented Application – Composite Application Programming Model.

Suggested Activities:

- Applications of SOA and MSA.
- OOAD and SOAD comparison.
- Identifying simple services based on SOA and MSA.

Suggested Evaluation Methods:

- Case studies of various SOA applications.
- Application based comparison.

UNIT III WEB SERVICES 9

XML – DOM and SAX Processors – SOAP – WSDL – UDDI – JSON – WS – Security – Web Services Standards – Java, .NET, Python Web Services – RESTful Web Services – Middleware Services for IoT – Mobile Services.

Suggested Activities:

- XML processing.
- Exploring the structure of SOAP, WSDL and UDDI.

- Creation of web services in Java/.NET/Python environment.
- RESTful web services.
- Study of middleware services for IoT.

Suggested Evaluation Methods:

- Implementing XML, DOM and SAX.
- Programming exercises.

UNIT IV SERVICE ORIENTED ANALYSIS AND DESIGN 9

Principles of Service Design – Design of Activity, Data, Client, Business Process Services – Resilience Services –Technologies for SOA – Service Enablement – Integration – Orchestration – SOA Governance – Design Time and Run Time Governance – SOA Best Practices – EA and SOA for IT Alignment.

Suggested Activities:

- Study of business process services.
- Orchestration of Web services.

Suggested Evaluation Methods:

- Quiz on service design principles.
- Demonstration - Orchestrated web services.

UNIT V MICROSERVICE BASED APPLICATIONS 9

Implementing Microservices with Python – Microservice Discovery Framework – Coding, Testing and Documenting Microservices – Interacting with Other Services – Monitoring and Securing the Services – Containerized Services – Deploying on Cloud.

Suggested Activities:

- Implementation of microservices architecture with Python.
- Creation of container services.
- Cloud deployment.

Suggested Evaluation Methods:

- Micro service based application case study.
- Cloud deployment in different platforms.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand different types of software architecture.
2. Understand the need for MSA over SOA.
3. Understand the XML based standards associated with SOA.
4. Analyze and design SOA based applications.
5. Create Microservices using different software frameworks.
6. Integrate various microservices for realizing enterprise like application.

REFERENCES:

1. Shankar Kambhampaty, “Service-oriented Architecture & Microservice Architecture: For Enterprise, Cloud, Big Data and Mobile”, Third Edition, Wiley, 2018.
2. Tarek Ziadé , “Python Microservices Development”, O'REILLY publication,2017.
3. Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005.
4. Ron Schmelzer et.al, “XML and Web Services”, Pearson education, 2002.
5. Leonard Richardson, Sam Ruby, “RESTful Web Services”, O'REILLY publication, 2007.
6. Nicolai M. Josuttis, “SOA in Design – The Art of Distributed System Design”, O'REILLY publication, 2007.
7. Raj Balasubramanian, Benjamin Carlyle, Thomas Erl, Cesare Pautasso, “SOA with REST – Principles, Patterns & Constraints for Building Enterprise Solutions with REST”, Prentice Hall, 2013.

CA5016 SOFTWARE PROJECT MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To develop an awareness of the need for project planning and management.
- To know about software effort estimation and activity planning.
- To explore risk and people management.
- To learn about project monitoring and control mechanisms.
- To know about software quality management.

UNIT I INTRODUCTION 9

Basics of Software Project Management: Definition – Software Projects Versus Other Types of Project – Contract Management and Technical Project Management – Activities – Plans, Methods and Methodologies – Requirement Specification – Management Control – Overview of Project Planning – Introduction to Step Wise Project Planning – Programme Management and Project Evaluation: Programme Management, Benefits, Evaluation, Technical Assessment, Cost -Benefit Analysis, Risk Evaluation – Selection of an Appropriate Project Approach: Choosing Technologies, Process Models, Software Prototyping, Dynamic Systems Development Method, Managing Iterative Processes.

Suggested Activities:

- Discussion on software project management planning.
- External learning - Process models.

Suggested Evaluation Methods:

- Assignment on project management framework.
- Quiz on process models.

UNIT II SOFTWARE EFFORT ESTIMATION AND ACTIVITY PLANNING 9

Software Effort Estimation: Problems with Over and Under Estimates – Basis of Software Estimating – Techniques – Expert Judgment – Cosmic Full Function Points – A Procedural Code Oriented Approach – COCOMO: A Parametric Model – Activity Planning: Objectives – Project Schedules – Projects and Activities – Sequencing and Scheduling Activities – Network Plannin0g Models – Formulating A Network Model – Identifying Critical Path – Shortening the Project Duration – Identifying Critical Activities – Activity-on-arrow Networks.

Suggested Activities:

- Discussion on software effort estimation methods.
- External learning - Software activity planning.

Suggested Evaluation Methods:

- Quiz on software effort estimation methods.
- Assignment on activity planning of a case study.

UNIT III SOFTWARE RISK AND PEOPLE MANAGEMENT 9

Categories of Risk – Framework for Dealing with Risk – Risk Identification – Risk Assessment – Risk Planning – Risk Management – Evaluating Risks to the Schedule – Applying the PERT Technique – Monte Carlo Simulation – Critical Chain Concepts – Resource Allocation: Nature of Resources – Identifying Resource Requirements – Scheduling Resources – Creating Critical Paths – Counting the Cost – Cost Schedules – Scheduling Sequence.

Suggested Activities:

- Discussion on risk management approaches.
- External learning on People Management.

Suggested Evaluation Methods:

- Assignment on risk management.
- Quiz on people management.

UNIT IV SOFTWARE PROJECT MONITORING AND CONTROL 9

Creating the Framework – Collecting the Data: Partial Completion Reporting – Risk Reporting – Visualizing Progress: Gantt chart – Slip chart – Ball Charts – The Timeline – Cost Monitoring – Earned Value Analysis – Prioritizing Monitoring – Getting the Project Back to Target – Change Control.

Suggested Activities:

- Discussion on project monitoring.
- External learning - Software control mechanisms.

Suggested Evaluation Methods:

- Assignment on project monitoring.
- Quiz on software control mechanisms.

UNIT V SOFTWARE QUALITY MANAGEMENT 9

Managing Contracts: The ISO 12207 Approach, Supply Process, Types, Stages, Contract Management Managing People and Organizing Teams: Understanding Behaviour, Organizational Behaviour, Motivation, The Oldham-Hackman Job Characteristics Model, Decision Making, Leadership, Dispersed and Virtual Teams, Software Quality – Importance, Defining Software Quality, ISO 9126, Software Quality Measures, Product Versus Process Quality Management, External Standards, Quality Plans.

Suggested Activities:

- Discussion on components of Software Quality Management.
- External learning on Software Quality measures.

Suggested Evaluation Methods:

- Assignment on various SQM standards and bodies.
- Quiz on software quality measures.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Differentiate between various software process models.
2. Prepare project planning documents.
3. Estimate the software cost for projects.
4. Perform effective activity planning.
5. Prepare effective project scheduling work product.
6. Perform software quality management activities.

REFERENCES:

1. Bob Hughes, Mike Cotterell, “Software Project Management”, Fourth Edition, Tata McGraw-Hill, 2011.
2. Walker Royce, “Software Project Management: A Unified Framework”, Pearson Education, 2004.
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5. Ramesh Gopalaswamy, “Managing Global Software Projects”, Tata McGraw Hill, 2001.
6. Humphrey Watts, “Managing the software process”, Addison Wesley, 1989.
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CA5017 MIXED REALITY L T P C

3 0 0 3

Attested

OBJECTIVES:

- To impart the fundamental aspects and principles of mixed reality technologies.

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- To know the internals of the hardware and software components involved in the development of mixed reality enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about mixed reality application development.
- To evaluate the mixed reality based applications.

UNIT I INTRODUCTION 9

Introduction to Virtual Reality – Definition – Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR – System Structure of Augmented Reality – Key Technology in AR – 3D Vision – Approaches to Augmented Reality – Alternative Interface Paradigms – Spatial AR – Input Devices – 3D Position Trackers – Performance Parameters – Types Of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

Suggested Activities:

- Flipped classroom on the use of MR applications.
- Experience the virtual reality effect by watching videos.
- Assignment on comparison of VR with traditional multimedia applications.

Suggested Evaluation Methods:

- Tutorial - MR applications.
- Brainstorming session - VR effects.
- Quizzes on difference between VR and Multimedia applications.

UNIT II MR COMPUTING ARCHITECTURE 9

Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering –PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – SGI Infinite Reality Architecture – Distributed VR Architectures – Multi-pipeline Synchronization – Collocated Rendering Pipelines – Distributed Virtual Environments – AR Architecture.

Suggested Activities:

- Flipped classroom on basic graphics pipeline.
- External learning - Different types of graphics architectures and workstations.
- Practical - GPU programming.

Suggested Evaluation Methods:

- Tutorial - Graphics pipeline.
- Brainstorming session - Graphics architectures.
- Quizzes on various topics of the unit.
- Demonstration of GPU programs for creating simple multimedia Applications.

UNIT III MR MODELING 9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing The 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing And Mapping – Behavior Modeling – Model Management.

Suggested Activities:

- Flipped classroom on modeling three dimensional objects.
- External learning - Collision detection algorithms.
- Practical - Creating three dimensional models.

Suggested Evaluation Methods:

- Tutorial - 3D modeling techniques.

- Brainstorming session - Collision detection algorithms.
- Demonstration of three dimensional models.

UNIT IV MR PROGRAMMING 9

VR Programming – Toolkits and Scene Graphs – World Toolkit – Java 3D – Comparison of World Toolkit and Java 3D - GHOST – People Shop – Human Factors in VR – Methodology And Terminology – VR Health and Safety Issues – VR and Society –Mixed Reality Coding –Trajectories through Mixed Reality Performance – Mobile Interface Design – Quantitative Evaluation – Qualitative Evaluation.

Suggested Activities:

- External learning - Different types of programming toolkits.
- Practical - Create VR scenes using toolkits like World ToolKit, Java 3D, Ghost, People Shop, Unity.

Suggested Evaluation Methods:

- Tutorial sessions on different programming toolkits for MR.
- Demonstration of MR scene creation.

UNIT V APPLICATIONS 9

Medical Applications of MR – Education, Arts and Entertainment – Military MR Applications – Emerging Applications of MR – MR Applications in Manufacturing – Applications of MR in Robotics – Information Visualization –Wearable Computing – Games.

Suggested Activities:

- External learning - Learn different types of available MR applications.
- Practical - Develop MR application in any domain of your interest.
- Tutorial - MR applications

Suggested Evaluation Methods:

- Evaluation of the developed MR application.
- Demonstration of MR application development and appropriate evaluation.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Discuss the basic concepts of Mixed Reality.
2. Design and develop the Mixed Reality applications in different domains.
3. Design various models using modeling techniques.
4. Perform Mixed Reality Programming with toolkits.
5. Understand the working principles of input output devices used in mixed reality applications.
6. Evaluate mixed reality based applications.

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1. Grigore C. Burdea, Philip Coiffet, “Virtual Reality Technology”, Second Edition, Wiley India, 2006.
2. Benford, S., Giannachi G., “Performing Mixed Reality”, MIT Press, 2011.
3. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create Compelling VR Experiences for Mobile”, Packt Publisher, 2018.
4. John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
5. William R. Sherman, Alan B.Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003.

CA5018 DIGITAL IMAGE PROCESSING AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To learn the basic concepts of digital image processing and various image transforms.
- To familiarize the student with the image enhancement techniques.
- To expose the student to a broad range of image processing techniques and their applications.
- To appreciate the use of current technologies that are specific to image processing systems.
- To expose the students to real-world applications of image processing.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction – Applications of Image Processing – Steps in Image Processing Applications –Digital Imaging System – Sampling and Quantization – Pixel Connectivity – Distance Measures – Colour Fundamentals and Models – File Formats – Image Operations.

Suggested Activities:

- Discussion on image processing applications.
- External learning - Open source tools like Octave/SciLab/OpenCV , types of images.
- Practical - Reading and writing of images in Matlab and OpenCV/Octave/SciLab.

Suggested Evaluation Methods:

- Tutorials on image operations, image connectivity and distance measures.
- Assignments on sampling, quantization and image operations.
- Quizzes on image types.

UNIT II IMAGE ENHANCEMENT 9

Image Transforms: Discrete Fourier Transform – Fast Fourier Transform – Discrete Cosine Transform – Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing –Spatial Filtering – Smoothing And Sharpening –Frequency Domain: Filtering in Frequency Domain.

Suggested Activities:

- Discussion of mathematical transforms.
- Numerical problem solving using Fourier transform.
- External learning - image noise and types of noises.
- Practical - Implementation of simple spatial filters like low pass filters and high pass filters in Matlab/OpenCV.

Suggested Evaluation Methods:

- Tutorials on image transforms, image smoothing.
- Assignments on histogram specification and equalization, spatial filters.
- Quizzes on noise modeling.

UNIT III IMAGE RESTORATION AND MULTI-RESOLUTION ANALYSIS 9

Multi Resolution Analysis: Image Pyramids – Multi Resolution Expansion – Wavelet Transforms – Image Restoration – Image Degradation Model – Noise Modeling – Blur – Order Statistic Filters – Image Restoration Algorithms.

Suggested Activities:

- Discussion on image artifacts and blur.
- Discussion on the role of wavelet transforms in filter and analysis.
- Practical - Implementation of noise modeling in Matlab/Octave/SciLab.
- Practical - Implementation of wavelet transforms and deconvolution algorithms in Matlab/Octave.

Suggested Evaluation Methods:

- Tutorials on wavelet transforms.
- Assignments ion order statistics fillters and multi resolution expansions.
- Quizzes on wavelet transforms.

UNIT IV IMAGE SEGMENTATION AND FEATURE EXTRACTION 9

Image Segmentation – Detection of Discontinuities –Edge Operators –Edge Linking and Boundary Detection – Thresholding – Region based Segmentation – Image Features and Extraction – Image Features – Types of Features – Feature Extraction – SIFT, SURF and Texture – Feature Reduction Algorithms.

Suggested Activities:

- Flipped classroom on importance of segmentation.
- External learning - Discussion of features, feature selection and reduction.
- Practical - Implementation of SIFT, SURF in Matlab/Octave/SciLab.
- Practical - Implementation of PCA in Matlab/Octave.

Suggested Evaluation Methods:

- Tutorials on image segmentation and edge detection.
- Assignments on feature extraction and reduction.
- Quizzes on feature selection and extraction.

UNIT V IMAGE PROCESSING APPLICATIONS 9

Image Classifiers – Supervised Learning – Support Vector Machines, Image Clustering – Unsupervised Learning – Hierarchical and Partition based Clustering Algorithms – EM Algorithm.

Suggested Activities:

- Discussion on machine learning in image processing.
- Discussion on image classifiers.
- Discussion on biometrics such as iris, fingerprint and face recognition.
- Discussion on image security such as steganography and digital watermarking.
- External learning - Medical imaging and remote sensing.
- External learning - Study of visual effects and Forensic applications.
- Practical - Image classifier using SVM in Matlab/Octave.
- Practical - Extraction of features in fingerprint using Matlab/Octave.

Suggested Evaluation Methods:

- Tutorials on image classifier and clustering.
- Assignments on support vector machines and EM algorithm.
- Quizzes on image processing applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Implement basic image processing operations.
2. Apply and develop new techniques in the areas of image enhancement and restoration.
3. Understand the image segmentation algorithms.
4. Extract features from images.
5. Apply classifiers and clustering algorithms for image classification and clustering.
6. Design and develop an image processing application that uses different concepts of image processing.

REFERENCES:

1. Rafael Gonzalez, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018.
2. S. Sridhar, “Digital Image Processing”, Second Edition, Oxford University Press, 2016.
3. Anil K. Jain, “Fundamentals of Digital Image Processing”, PHI, 2011.
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”, Fourth Edition, Cengage India, 2017.

CA5019 **TEXT MINING TECHNIQUES** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the basic issues and needs of text mining.
- To appreciate the different aspects of text categorization and clustering.
- To understand the role played by text mining in information retrieval and extraction.
- To appreciate the use of probabilistic models and its principles applicable in text mining.
- To appreciate the current trends in text mining on various systems.

UNIT I INTRODUCTION 8

Overview of Text Mining – Definition – General Architecture – Algorithms – Core Operations – Preprocessing – Types of Problems – Basics of Document Classification – Information Retrieval – Clustering and Organizing Documents – Information Extraction – Prediction and Evaluation – Textual information to Numerical Vectors – Collecting Documents – Document Standardization – Tokenization – Lemmatization Vector Generation for Prediction – Sentence Boundary Determination – Evaluation Performance.

Suggested Activities:

- Develop a web application for search engine.
- Tokenize the given text information using any parser.
- Practical - Implement all the preprocessing steps needed for text mining.

Suggested Evaluation Methods:

- Evaluation of the implementations the preprocessing steps in laboratory environment.

UNIT II TEXT CATEGORIZATION AND CLUSTERING 10

Text Categorization – Definition – Document Representation – Feature Selection – Decision Tree Classifiers – Rule – based Classifiers – Probabilistic and Naive Bayes Classifiers – Linear Classifiers Classification of Linked and Web Data – Meta-Algorithms – Clustering – Definition – Vector Space Models – Distance Based Algorithms – Word and Phrase – based Clustering – Semi – Supervised Clustering – Transfer Learning.

Suggested Activities:

- Role playing to be carrying out for grouping the students to understand the working principles of clustering and classification.

Suggested Evaluation Methods:

- Assignments on analyzing the performance of different clustering and classification algorithms and show the best performance of each algorithm for any specific application.

UNIT III TEXT MINING FOR INFORMATION RETRIEVAL AND INFORMATION EXTRACTION 10

Information Retrieval and Text Mining – Keyword Search – Nearest Neighbor Methods – Similarity – Web Based Document Search – Matching – Inverted Lists – Evaluation – Information Extraction – Architecture – Co-Reference – Named Entity and Relation Extraction – Inductive – Unsupervised Algorithms for Information Extraction – Text Summarization Techniques – Topic Representation – Influence of Context – Indicator Representations – Pattern Extraction – Apriori Algorithm – FP Tree Algorithm.

Suggested Activities:

- In-class activity - Name Entity and relation extraction using role play game.
- In-class activity - Show the working principle of searching technique.

Suggested Evaluation Methods:

- Assignments on developing flash or animated presentation for explaining the working principles of any one algorithm for information retrieval and extraction.

Attested

UNIT IV PROBABILISTIC MODELS 9

Probabilistic Models for Text Mining – Mixture Models – Stochastic Processes in Bayesian

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Nonparametric Models – Graphical Models – Relationship Between Clustering – Dimension Reduction and Topic Modeling – Latent Semantic Indexing – Latent Dirichlet Allocation – Interpretation and Evaluation – Probabilistic Document Clustering and Topic Models – Probabilistic Models for Information Extraction – Hidden Markov Models – Conditional Random Fields.

Suggested Activities:

- In-class activity - Document clustering and information extraction.
- External learning - Markov models and entropy models.

Suggested Evaluation Methods:

- Tutorial - Topic modeling to show its behavior on different data types.

UNIT V RECENT TRENDS 8

Visualization Approaches – Architectural Considerations – Visualization Techniques in Link Analysis – Example – Mining Text Streams – Text Mining in Multimedia – Text Analytics in Social Media – Opinion Mining and Sentiment Analysis – Document Sentiment Classification – Aspect – Based Sentiment Analysis – Opinion Spam Detection – Text Mining Applications and Case Studies.

Suggested Activities:

- In-class activity - Visualization approaches.
- External learning - Text mining applications and case studies.

Suggested Evaluation Methods:

- Assignments on extracting the sentiment expressed in any given sentence using opinion word.
- Tutorial - Methodologies available to detect the spam in opinion mining.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Identify the different features that can be mined from text and web documents.
2. Use available open source classification and clustering tools on some standard text data sets.
3. Modify existing classification or clustering algorithms in terms of functionality or features used.
4. Design a system that uses text mining to improve the functions of an existing open source search engine.
5. Implement a text mining system that can be used for an application of your choice.
6. Use the opinion mining concepts to extract the sentiment from the large database.

REFERENCES:

1. Weiss, S. M., Indurkhya, N., Zhang, T., Damerau, F, “Text Mining: Predictive Methods for Analyzing Unstructured Information”, Springer, 2005.
2. Ronen Feldman, James Sanger “The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data”, Cambridge University Press, 2009.
3. Michael Berry, “Survey of Text Mining: Clustering, Classification and Retrieval”, Springer, 2004.
4. Hercules Antonio do Prado, Edilson Fernada, “Emerging Technologies of Text Mining: Techniques and Applications”, Information Science Reference, 2008.
5. Charu C. Aggarwal, Cheng Xiang Zhai, “Mining Text Data”, Springer, 2012.

CA5020 DATA WAREHOUSING AND DATA MINING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To get exposed to the concepts of data warehousing architecture and implementation.
- To conceptualize data mining and the need for pre-processing and to analyze the mining techniques for realistic data.

- To characterize the kinds of patterns that can be discovered by association rule mining.
- To implement classification and clustering techniques on large datasets.
- To identify business applications and trends of data mining.

UNIT I DATA WAREHOUSE 9

Data Warehousing – Operational Database Systems versus Data Warehouses – Multidimensional Data Model – Schemas for Multidimensional Databases – OLAP operations – Data Warehouse Architecture – Indexing – OLAP queries & Tools.

Suggested Activities:

- Assignments on data warehouse modeling using a real time scenario.
- Assignment on describing the similarities and the differences of the multidimensional models and analyzing their advantages and disadvantages with regard to one another.
- Practical - Implementing various OLAP operations on a multidimensional data.
- Practical - Execute multidimensional data model using SQL queries.
- Discussion on the advantages of indexing structures.

Suggested Evaluation Methods:

- Tutorial - Case study on OLAP schema level representation and OLAP operations.
- Assignment on OLAP operations and schema level representation.
- Tutorial - Building a data warehouse using open source tools such as Talend.

UNIT II DATA MINING & DATA PREPROCESSING 9

Introduction to KDD Process – Knowledge Discovery from Databases – Need for Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation.

Suggested Activities:

- Discussion on knowledge discovery database.
- Assignments on numerical problems on smoothing, normalization and attribute subset selection.
- Evaluate attribute relevance analysis on a real time application data warehouse.
- Evaluate information gain of an attribute in a real time database.

Suggested Evaluation Methods:

- Tutorial - Data cleaning and data transformation.
- Assignments on data integration and transformation.
- Assignment on data reduction and data discretization.
- Quizzes on data preprocessing.

UNIT III ASSOCIATION RULE MINING 9

Introduction – Data Mining Functionalities – Association Rule Mining – Mining Frequent Itemsets with and without Candidate Generation – Mining Various Kinds of Association Rules – Constraint – Based Association Mining.

Suggested Activities:

- Discussion and problem solving of different association rule mining algorithms (Apriori algorithms and FP-Growth algorithms).
- Practical - Implementation of association rule mining using Data mining tools such as Weka.
- Practical - Comparing the performance of each algorithm with various kinds of large data sets.

Suggested Evaluation Methods:

- Quizzes on different data mining functionalities and types of association rule mining.
- Tutorial - Different real time applications of association rule mining.

UNIT IV CLASSIFICATION & PREDICTION 9

Classification versus Prediction – Data Preparation for Classification and Prediction – Classification by Decision Tree – Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

Suggested Activities:

- Discussion on tree pruning.
- Assignments on calculation of the computational complexities and accuracy of the classification algorithms.
- Discussion on different real-time applications of classification and evaluating the accuracy of a classifier.
- Assignments on problem solving of classification algorithms.
- Comparative study on different classification algorithms.

Suggested Evaluation Methods:

- Quizzes on different classification methods.
- Tutorial - Accuracy and error measures different classification methods.
- Assignment on support vector machines.

UNIT V CLUSTERING 9

Cluster Analysis – Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Model Based Clustering Methods – Clustering High-Dimensional Data – Constraint Based Cluster Analysis – Outlier Analysis.

Suggested Activities:

- Comparative study on the various clustering algorithms.
- Discussion on real time applications of outlier analysis.
- Practical - Implementation of clustering algorithms using data mining tools.
- Practical - Design and implementation of a clustering method that finds clusters in large data cubes effectively and efficiently.
- Assignments on comparative study of clustering algorithms in terms of the following criteria: shapes of clusters that can be determined by input parameters that must be specified and limitations.
- Assignments on categorization such as to categorize the kinds of constraints that can be imposed on the clusters produced and discuss how to perform clustering efficiently under such kinds of constraints.
- Practical - Develop an application where the border between normal objects and outliers is often unclear, so that the degree to which an object is an outlier has to be well estimated.

Suggested Evaluation Methods:

- Quizzes different types of clustering methods.
- Tutorial - High-dimensional data clustering.
- Assignment on density based, grid based and model based clustering methods.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Design, create and maintain data warehouses.
2. Apply data mining techniques and methods to large data sets.
3. Evaluate various mining techniques on complex data objects.
4. Evolve multidimensional intelligent model from typical system.
5. Discover the knowledge imbibed in the high dimensional system.
6. Understand various tools of data mining and their techniques to solve the real time problems.

REFERENCES:

1. Jiawei Han, Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.
2. K. P. Soman, Shyam Diwakar, V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, “Introduction to Data Min Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, Third Edition, 2014.
4. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Second Edition, Elsevier, 2015.
5. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
6. Ian H. Witten, Eibe Frank, Mark A. Hall, “Data Mining: Practical Machine Learning Tools and Techniques”, Third Edition, Morgan Kaufmann, 2011.
7. George M. Marakas, “Modern Data Warehousing, Mining and Visualization: Core Concepts”, Prentice Hall, 2002.
8. Bruce Ratner, “Statistical and Machine Learning Data Mining: Techniques for Better Predictive Modeling and Analysis of Big Data”, Second Edition, CRC Press, 2012.

CA5021 SOFTWARE QUALITY ASSURANCE L T P C
3 0 0 3

OBJECTIVES:

- To gather knowledge on quality management, documentation and controlling for software quality.
- To provide knowledge on standards, models and tools used for quality management.
- To perform measurement and assessment of software quality.
- To introduce the basics and necessity of software testing.
- To introduce various testing techniques along with software production.

UNIT I INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE 9

Need for Software Quality – Quality Challenges – Software Quality Assurance (SQA) – Definition and Objectives – Software Quality Factors – McCall's Quality Model – SQA System and Architecture – Software Project Life Cycle Components – Management of SQA components – Pre-Project Software Quality Components – Contract Review – Development and Quality Plans.

Suggested Activities:

- External learning - Software quality models.
- Report on quality plans.

Suggested Evaluation Methods:

- Assignment on quality models and quality plans.
- Evaluation of report.

UNIT II SQA COMPONENTS AND PROJECT LIFE CYCLE 9

Software Development Methodologies – Quality Assurance Activities in the Development Process – Verification, Validation and Qualification – Reviews: Objectives – Formal design Review – Peer Review – Quality of Software Maintenance Components – Pre-Maintenance Software Quality Components – Maintenance Software Quality Assurance Tools – Assuring the Quality of External Participants Contributions: Objectives, Types, Risks and Benefits – Tools: CASE Tools and Their Effect on Software Quality.

Suggested Activities:

- Discussion on software quality assurance components.
- External learning - Quality assurance tools.

Suggested Evaluation Methods:

- Quiz on software quality assurance components.

- Assignment on quality assurance tools.

UNIT III SOFTWARE QUALITY INFRASTRUCTURE 9

Procedures and Work Instructions – Supporting Quality Devices – Templates – Checklists – Staff Training and Certification – Corrective and Preventive Actions – Configuration Management – Software Change Control – Configuration Management Audit – Documentation Control – Storage and Retrieval.

Suggested Activities:

- Discussion on configuration management audit.
- Discussion on documentation control.

Suggested Evaluation Methods:

- Assignment on configuration management audit report.
- Quizzes on templates and checklist preparation.
- Quiz on documentation control.

UNIT IV SOFTWARE QUALITY MANAGEMENT, METRICS & STANDARDS 9

Project Process Control – Computerized Tools – Software Quality Metrics – Objectives of Quality Measurement – Process Metrics – Product Metrics – Implementation – Limitations of Software Metrics – Cost Of Software Quality – Classical Quality Cost Model – Extended Model – Application of Cost Model. Quality Management Standards – ISO 9001 And ISO 9000-3 – Capability Maturity Models (CMM & CMMI) – Organization of Quality Assurance – Department Management Responsibilities – Project Management Responsibilities – SQA Units and Other Actors in SQA Systems.

Suggested Activities:

- Discussion on ISO quality standards.
- External learning - Software quality metrics.

Suggested Evaluation Methods:

- Assignment on ISO quality standards.
- Quiz on process and product metrics.

UNIT V SOFTWARE TESTING 9

Definition and Objectives – Software Testing Strategies – Software Test Classifications – White Box Testing: Data Processing, Calculation Correctness Tests, Mccabe's Cyclomatic Complexity Metrics, Software Qualification and Reusability Testing, Advantages and Disadvantages of White Box Testing – Black Box Testing: Equivalence Classes for Output Correctness Tests, Revision Factor Testing Classes, Transition Factor Testing Classes, Advantages and Disadvantages of Black Box Testing – Implementation: The Testing Process – Test Case Design – Automated Testing – Alpha and Beta Site Testing Programs.

Suggested Activities:

- Discussion on test case generation and testing methods.

Suggested Evaluation Methods:

- Assignment on test case generation tools.
- Quiz on testing procedures.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Learn document control and manage software quality with the aid of tools and standards.
2. Distinguish between various software quality models.
3. Measure and assess software quality through process and product metrics.
4. Distinguish between the software quality standards.
5. Perform automated testing using test tools.

6. Document the testing procedures.

REFERENCES:

1. Daniel Galin, “Software Quality Assurance: From theory to implementation”, Pearson Education, 2004.
2. Stephen H. Kan, “Metrics and Models in Software Quality Engineering”, Pearson Education, 2002.
3. Mordechai Ben-Menachem, Garry S. Marliss, “Software Quality”, BSP, Second Edition, 2014.
4. Allan C. Gillies, “Software Quality: Theory and Management”, Thomson Learning, 2003.
5. Glenford J. Myers, Tom Badgett, Corey Sandler, “The Art of Software Testing”, Third Edition, John Wiley & Sons, 2012.
6. Ron Patton, “Software testing”, Second Edition, Pearson Education, 2009.
7. Srinivasan Desikan, Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson Education, 2009.

CA5022 INTRODUCTION TO SOCIAL NETWORK ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To gain knowledge about the empirical and theoretical study of social networks, its structure and social network data sources.
- To study about the semantic technologies for social network analysis.
- To gain knowledge on visualization of social networks and its applications.
- To gain knowledge about social network analysis software for characterizing the network structure.
- To engage in critical thinking regarding the applicability of social network theory to various sociological phenomena.

UNIT I INTRODUCTION 9

Social Network Analysis: Definition and Features – The Development of Social Network Analysis – Basic Graph Theoretical Concepts of Social Network Analysis – Ties, Density, Path, Length, Distance, Betweenness, Centrality, Clique – Electronic Sources for Network Analysis – Electronic Discussion Networks, Blogs and Online Communities, Web-based Networks – Applications of Social Network Analysis.

Suggested Activities:

- Practical - Study of existing social networks and calculate the social network related metrics.
- Flipped classroom on fundamental mathematical knowledge on graphs and tutorial activity.
- External learning - Problems on calculation of ties, density, path, length, distance, betweenness, centrality, clique.

Suggested Evaluation Methods:

- Demonstration of social network creation and calculating the related metrics.
- Tutorial - Graphs and its related terminologies.
- Assignments on calculation of ties, density, path, length, distance, betweenness, centrality, clique.

UNIT II SOCIAL NETWORK ANALYSIS 9

Introduction to Social Networks Profiles – Types of Commercial Social Network Profiles (CSNP) – Quantitative and Qualitative Analysis of CSNP – Analysis of Social Networks Extracted from Log Files – Data Mining Methods Related to SNA and Log Mining – Clustering Techniques – Case Study.

Suggested Activities:

- Practical - Analysis of social network dataset.
- Flipped classroom on emerging applications of data mining based social network analysis techniques.

- External learning - Case study related to SNA.

Suggested Evaluation Methods:

- Demonstration of the analysis of social network log dataset.
- Tutorials on data mining applications.
- Assignments on data mining on SNA.

UNIT III SEMANTIC TECHNOLOGY FOR SOCIAL NETWORK ANALYSIS 9

Introduction to Ontology based Knowledge Representation – Ontology Languages for the Semantic Web – RDF and OWL – Modeling Social Network Data – Network Data Representation, Ontological Representation of Social Individuals and Relationships –Aggregating and Reasoning with Social Network Data – Advanced Representations.

Suggested Activities:

- Practical - Use of the features available in various ontology tools like Protégé.
- Flipped classroom on basic concepts of semantic web and ontology.
- External learning - Knowledge on semantic technology.

Suggested Evaluation Methods:

- Demonstration of created ontology.
- Tutorials **-** Semantic web related terminologies.
- Quizzes on semantic technology for SNA.

UNIT IV SOCIAL NETWORK MINING 9

Detecting and Discovering Communities in Social Network: Evaluating Communities –Methods for Community Detection – Applications of Community Mining Algorithms –Ethical Practices in Social Network Mining – Understanding and Predicting Human Behavior for Social Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities – Inferential Methods in Social Network Analysis.

Suggested Activities:

- Practical - Detection and mining of communities using various tools.
- Flipped classroom on basic concepts of online social networks (OSNs) and social network mining algorithms.
- External learning - Practical problems related to evaluation of community metrics.

Suggested Evaluation Methods:

- Demonstration - Community creation and mining.
- Tutorials on Social Network Mining.
- Assignments on community detection methods.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9

Visualization of Social Networks Node-Edge Diagrams – Random Layout – Force-Directed Layout – Tree Layout – Matrix Representations –Matrix and Node-Link Diagrams – Hybrid Representations – Visualizing Online Social Networks – Applications – Covert Networks – Community Welfare – Collaboration Networks – Co-Citation Networks – Data Privacy in Social Networks

Suggested Activities:

- Practical - Knowledge about tools related to social networks and implementation of social network visualizations using tools such as Gephi, Cytoscape.
- Flipped classroom on applications of social networks.
- External learning - How visualization is used in various real time SN applications.

Suggested Evaluation Methods:

- Demonstration of visual social networks
- Tutorials on applications of social networks.
- Quizzes on types of visualizations for social networks

- Group discussion on privacy and security of Aadhar.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand basic principles behind network analysis algorithms and develop practical skills of network analysis.
2. Model and represent knowledge for social semantic Web.
3. Apply data mining techniques on social networks.
4. Use extraction and mining tools for analyzing Social networks.
5. Develop secure social network applications.
6. Develop personalized visualization for Social networks.

REFERENCES:

1. Peter Mika, “Social Networks and the Semantic Web”, Springer, 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 2010.
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4. GuandongXu, Yanchun Zhang, Lin Li, “Web Mining and Social Networking Techniques and Applications”, Springer, 2011.
5. Max Chevalier, Christine Julien, Chantal Soulé-Dupuy, “Collaborative and Social Information Retrieval and Access: Techniques for Improved User Modelling”, IGI Global, 2009.
6. John G. Breslin, Alexandre Passant, Stefan Decker, “The Social Semantic Web”, Springer, 2009.
7. John Scott, Peter J. Carrington, “The SAGE Handbook of Social Network Analysis”, Sage Publication, 2011.

CA5028 WIRELESS SENSOR NETWORKS & PROTOCOLS L T P C

3 0 0 3

OBJECTIVES:

- To learn about the physical layer and MAC layer of WSNs.
- To understand the data centric computing to be followed in WSNs.
- To study about the routing protocols followed in WSNs.
- To study about data aggregation and in – network processing.
- To explore various motes, sensor network operating systems, databases and development platforms.

UNIT I FUNDAMENTALS OF WSN 9

Wireless Adhoc Networks – Distributed Sensing – Sensors and Transducers – Types of Sensors – Accuracy, Resolution and Hysteresis – Architecture of a Sensor Node and WSN – Sensor Network Design Considerations – Energy Efficient Design Principles for WSNs – Applications of WSNs.

Suggested Activities:

- External learning - Exploring various sensors, the corresponding actuators, various motes and their configuration (sensors supported, microcontroller and the clock speed, Flash, RAM, Battery capacity, RF transceivers and data rate supported).
- Flipped classroom on accuracy, hysteresis and resolution of sensors.
- Assignments on calculations of energy requirement for transmission, receiving and channel sensing.

Suggested Evaluation Methods:

- Assignments on various types of sensors, actuators and motes.
- Quiz and discussion on accuracy, hysteresis and resolution of sensors.
- Assignments on problems related to energy consumption in WSNs.

Attested

UNIT II MAC LAYER OF WSN AND ZIGBEE STANDARD 9

Energy Issues in Transceiver Design and Channel Access – PHY Frame Structure – Roles of Nodes

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– End device, Router and Coordinator – Full Function Device and Reduced Function Device – Star, Mesh and Tree topology – Medium Access Control – Duty Cycle S – MAC Protocol – IEEE 802.15.4 Standard and ZigBee.

Suggested Activities:

- External learning - A study of Wireless HART, 6LoWPAN and ISA 100.11a standards.
- Flipped classroom on different roles of nodes in WSNs and different types of ZigBee devices.
- Analyzing duty cycle and sleep cycle of S-MAC protocol.

Suggested Evaluation Methods:

- Assignments on various standards available for WSNs.
- Quiz and discussion on roles of nodes and different types of ZigBee devices.
- Assignments on problems related to duty cycle of S-MAC protocol.

UNIT III DATA CENTRIC COMPUTING IN WSN 9

Data Gathering and Dissemination – Broadcasting and Geo Casting from Sink – Data Aggregation – LMST Based Aggregation – Power Efficient Data Gathering and Aggregation (PEDAP) – In-Network Processing – Aggregate Queries – Routing Challenges and Strategies in WSNs – SPIN, Directed Diffusion, Rumour Routing, Energy Aware Routing, Gradient based Routing.

Suggested Activities:

- Flipped classroom on data centric computing and information centric networks.
- Assignments on analyzing the generation and consumption of energy with nonconventional energy sources.
- External learning - Sensor network platforms and tools and sensor network databases.

Suggested Evaluation Methods:

- Quiz and discussion on data centric computing and information centric networks.
- Assignments on problems regarding generation and consumption of energy sources.
- Assignments on sensor network platforms, tools and sensor network databases.

UNIT IV SYNCHRONIZATION, LOCALIZATION AND TRACKING IN WSNs9

Sensor Management – Topology Control Protocols and Sensing Mode Selection Protocols – Time Synchronization – Localization and Positioning – Ranging Techniques – Range Based Localization Algorithms – Location Services – Scene Analysis, GPS and RFID.

Suggested Activities:

- External learning - Exploring tracking of objects using ultrasonic sensors and camera nodes.
- Exploring the idea of smart cities using Object Tracking Sensor Networks (OTSN).
- Flipped classroom on scene analysis, GPS, RFID and location based services.

Suggested Evaluation Methods:

- Assignments on tracking of objects using ultrasonic sensors and camera nodes.
- Assignments on designing WSNs to locate and track moving objects using ultrasonic sensors or camera nodes for smart cities.
- Quiz and discussion on scene analysis, GPS, RFID and location based services.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Network Hardware – Berkeley Motes – Arduino IDE – Node Level Software Platforms – Tiny OS – Imperative Language – nesC – Simulators – ns3, Contiki OS and COOJA IDE, TOSSIM – State Centric Programming – PIECES – A State Centric Framework – Google for Physical World – Role of WSN in IoT.

Suggested Activities:

- Practical - Exploring various network simulators available to carry out experiments in WSNs and various WSN testbeds: WISBED, SensLAB, MoteLAB, CitySense and Sensei.
- Flipped classroom on Contiki OS and COOJA IDE.
- Assignments on developing Arduino sketches and WSN simulation in NS3.

Suggested Evaluation Methods:

- Assignments on WSN simulators and WSN testbeds.
- Quiz and discussion on Contiki OS and COOJA IDE.
- Assignments on writing Arduino sketches for socially relevant projects and creating a sensor network topology in ns – 2.35 with Mannasim patch or in NS3.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand different types of sensors, their actuators and the architecture of motes.
2. Design the topology of WSNs using different types of ZigBee devices and understanding their roles.
3. Understand and apply data centric computing in wireless sensor networks.
4. Apply appropriate localization techniques for different scenarios.
5. Manage sensor networks by synchronizing the time, locating and tracking objects.
6. Carry out experiments in simulators and real sensors.

REFERENCES:

1. Mohammed A. Matin, "Wireless Sensor Networks: Technology and Protocols", InTech, 2012.
2. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
3. Robert Faludi, "Building Wireless Sensor Networks", O'Reilly Media, 2011.
4. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufmann, 2004.
5. Bob Tucker, "Wireless Sensor Networks: Signals and Communication Technology", NY Research Press, 2015.

CA5032 SEMANTIC WEB AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To learn the fundamentals of semantic web and to conceptualize and depict ontology for semantic web.
- To make a study of languages for semantic web.
- To learn about the ontology learning algorithms and to utilize in the development of an application.
- To know the fundamental concepts of ontology management.
- To learn the applications related to semantic web.

UNIT I THE QUEST FOR SEMANTICS 9

Building Models – Calculating with Knowledge – Exchanging Information – Semantic Web Technologies – Layers – Architecture – Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background – Sample Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation.

Suggested Activities:

- Flipped classroom on semantic web background and tutorial activity.
- Brainstorming session - Various knowledge representation formats.
- Practical - Design of simple ontology on their domain of interest using tools like Protégé.
- Practical - Installing EasyRdf in the system and including this in PHP (EasyRdf is a PHP library, which can be used to consume and produce RDF).

Suggested Evaluation Methods:

- Tutorials on semantic web basics.
- Quizzes on knowledge representation formats

- Demonstration of simple implemented ontology.

UNIT II LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES 9

Web Documents in XML – RDF – Schema – Web Resource Description using RDF – RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics –Traditional Ontology Languages – LOOM – OKBC – OCML – FLogic Ontology Markup Languages – SHOE – OIL – DAML + OIL – OWL.

Suggested Activities:

- Flipped classroom on comparison of various semantic web related languages and tutorial.
- Practical - Creation of RDF documents.
- Practical - Use of OWL language to represent relationships, properties and to provide inferences from created ontology.

Suggested Evaluation Methods:

- Quizzes on various ontology related languages
- Demonstration of knowledge inference from created ontologies.

UNIT III ONTOLOGY LEARNING FOR SEMANTIC WEB 9

Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning –Importing and Processing Ontologies and Documents – Ontology Learning Algorithms –Methods for Evaluating Ontologies.

Suggested Activities:

- Flipped classroom on natural language processing techniques like statistical text analysis, term extraction, word sense disambiguation, concept extraction and tutorial activity.
- Practical - Term extraction and term disambiguation from corpus using Alchemy like API.
- Extended Reading from the site - https://nlp.stanford.edu/fsnlp/.

Suggested Evaluation Methods:

- Tutorials on language processing techniques.
- Demonstration on term extraction and term disambiguation.

UNIT IV ONTOLOGY MANAGEMENT AND TOOLS 9

Overview – Need for Management – Development Process – Target Ontology – Ontology Mapping – Skills Management System – Ontological Class – Constraints – Issues, Evolution – Development Of Tools And Tool Suites – Ontology Merge Tools – Ontology Based Annotation Tools.

Suggested Activities:

- Flipped classroom on study of various ontology related tools.
- Practical - Use of any tool to apply SPARQL queries and implement reasoning for avoiding inconsistencies
- Practical - Merging two ontologies, applying association rules, applying clustering algorithms

Suggested Evaluation Methods:

- Tutorials on ontology related tools like Protege, Ontolingua, Webonto.
- Demonstration of clustering, merging ontologies and Sparql queries.

UNIT V APPLICATIONS 9

Web Services – Semantic Web Services – Case Study for Specific Domain – Security Issues – Web Data Exchange and Syndication - Semantic Wikis – Semantic Portals – Semantic Metadata in Data Formats – Semantic Web in Life Sciences – Ontologies for Standardizations – Rule Interchange Format.

Suggested Activities:

- Flipped classroom on other applications of semantic web.
- Practical - Simple application like chat bot, semantic search engine creation using topic map data models extracted from Ontopia/Mappa.

- Practical - Creating intelligent expert systems using semantic Wikis like SMW+.

Suggested Evaluation Methods:

- Quizzes on semantic web applications
- Demonstration of applications created using tools.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Create ontology for a given domain.
2. Develop an application using ontology languages and tools.
3. Understand the concepts of semantic web.
4. Use ontology related tools and technologies for application creation.
5. Design and develop applications using semantic web.
6. Understand the standards related to semantic web.

REFERENCES:

1. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, "Foundations of Semantic Web Technologies", Chapman & Hall/CRC, 2009.
2. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez "Ontological Engineering: with Examples from the Areas of Knowledge Management, E-Commerce and the Semantic Web", Springer, 2004.
3. Grigoris Antoniou, Frank van Harmelen, "A Semantic Web Primer (Cooperative Information Systems)", The MIT Press, 2004.
4. Alexander Maedche, "Ontology Learning for the Semantic Web", Springer, 2002.
5. John Davies, Dieter Fensel, Frank Van Harmelen, "Towards the Semantic Web: Ontology – Driven Knowledge Management", John Wiley, 2003.
6. John Davies, Rudi Studer, Paul Warren, "Semantic Web Technologies: Trends and Research in Ontology-based Systems", Wiley, 2006.

CA5033 SOFT COMPUTING L T P C
3 0 0 3

OBJECTIVES:

- To gain knowledge of soft computing theories and its fundamentals.
- To design a soft computing system required to address a computational task.
- To learn and apply artificial neural networks, fuzzy sets and fuzzy logic and genetic algorithms in problem solving and use of heuristics based on human experience.
- To introduce the ideas of fuzzy sets, fuzzy logic and to become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems.
- To familiarize with genetic algorithms and other random search procedures while seeking global optimum in self – learning situations.

UNIT I FUZZY COMPUTING 9

Basic Concepts of Fuzzy Logic, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion Membership Functions, Interference in Fuzzy Logic, Fuzzy If – Then Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzifications and Defuzzificataions, Fuzzy Controller, Industrial Applications.

Suggested Activities:

- Install MatLab Fuzzy Logic Toolbox and ANN toolbox to design and simulate systems.

Suggested Evaluation Methods:

- Quiz – basic concepts of fuzzy logic and operations.

UNIT II FUNDAMENTALS OF NEURAL NETWORKS 9

Neuron, Nerve Structure and Synapse, Artificial Neuron and its Model, Activation Functions, Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks. Various Learning Techniques; Perception and Convergence Rule, Auto-Associative and Hetero-Associative Memory.

Suggested Activities:

- Develop a supervised model to Train neural net that uses the AND/OR/XOR two input binary/ bipolar input and output data and learn linear models to understand the importance of initialization parameters.

Suggested Evaluation Methods:

- Project Demonstration.
- Implementation Evaluation with new input set.

UNIT III BACKPROPAGATION NETWORKS 9

Back Propagation Networks) Architecture: Perceptron Model, Solution, Single Layer Artificial Neural Network, Multilayer Perception Model; Back Propagation Learning Methods, Effect of Learning Rule Co – Efficient ;Back Propagation Algorithm, Factors Affecting Back Propagation Training, Applications.

Suggested Activities:

Develop a supervised model to

- Train neural net that uses the XOR three input binary/ bipolar input and output data and learn linear models to understand the importance of learning parameters.
- Train a linear / nonlinear model with one hidden layer, two hidden layers etc.
- Observe the performance with different learning rates and draw the graph depicting the error rate with iterations.

Suggested Evaluation Methods:

- Project Demonstration.
- Implementation Evaluation with new input set.

UNIT IV COMPETETIVE NEURAL NETWORKS 9

Kohenen's Self Organizing Map – SOM Architecture, learning procedure – Application; Learning Vector Quantization – learning by LVQ; Adaptive Resonance Theory – Learning procedure – Applications.

Suggested Activities:

Develop an unsupervised model to

- Train neural net that uses any Dataset and Plot the cluster of patterns.

Suggested Evaluation Methods:

- Project Demonstration.
- Implementation Evaluation with new input set.

UNIT V GENETIC ALGORITHM 9

Basic Concepts, Working Principle, Procedures of GA, Flow Chart of GA, Genetic Representations, (Encoding) Initialization and Selection, Genetic Operators, Mutation, Generational Cycle, Applications.

Suggested Activities:

- Implement GA for the travelling salesman problem to find the shortest path that visits all cities in a set exactly once.

Suggested Evaluation Methods:

- Implementation evaluation by testing the code on different route map and check the optimal solution.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Identify and describe soft computing techniques and their roles in building intelligent machines.
2. Recognize the feasibility of applying a soft computing methodology for a particular problem.
3. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
4. Apply genetic algorithms to optimization problems.
5. Design neural networks to pattern classification and regression problems using soft computing approach.
6. Describe the importance of tolerance of imprecision and uncertainty to a design of robust and low cost intelligent machines.

REFERENCES:

1. S. Rajasekaran and G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice Hall of India, 2010.
2. J.S.R. Jang, C.T. Sun and E. Mizutani, “Neuro – Fuzzy and Soft Computing”, Pearson Education, 2004.
3. S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, Second Edition, Wiley, 2007.
4. Siman Haykin, “Neural Networks”, Prentice Hall, 1999.
5. Timothy Ross, “Fuzzy Logic with Engineering Applications”, Wiley Publications, 2016.
6. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson Education, 2008.

CA5034	COGNITIVE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition.

UNIT I PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE 9

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn – The Philosophy of Science – The Mind in Cognitive Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Neurosciences: Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

Suggested Activities:

- Flipped classroom on logic and sciences in the mind.
- Case study on how philosophy (western and eastern), psychology and neuroscience (thought process in normal persons, children and differently abled) helps in cognition.
- Mind map of cognition with various attributes such as mind, logic, information processing etc.
- Discussion and debate on cognition.

Suggested Evaluation Methods:

- Quiz on the topic logic and sciences in the mind.
- Active discussion on the case study of how the factors such as learning and memory affect cognition.
- Essay writing on how various factors influence cognition.

UNIT II COMPUTATIONAL INTELLIGENCE 9

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Decision making under Uncertainty – Learning – Language – Vision – Robotics.

Suggested Activities:

- Flipped classroom on knowledge-based systems.
- Mind map on different methods of cognition in computational domain.
- Discussion on the influence of human cognition systems with a link to computational domain.

Suggested Evaluation Methods:

- Quiz on knowledge-based systems.
- Collaborative wiki editing of computational tools linking with cognition.
- Essay writing on the computational cognitive systems with the background of human cognitive systems.

UNIT III PROBABILISTIC PROGRAMMING LANGUAGE 9

WebPPL Language – Syntax – Using JavaScript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration – Other basic computation.

Suggested Activities:

- Flipped classroom on JavaScript libraries.
- Exploration of the existing mathematical models.
- Practical - Programming the common mathematical functions using PPL.

Suggested Evaluation Methods:

- Quiz on the basics of JavaScript and WebPPL.
- Practical - Programming assignment on developing miniature programs using WebPPL for inference mechanisms.
- Evaluation of the programming assignments.

UNIT IV IMPLEMENTING THE INFERENCE MODELS OF COGNITION 9

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

Suggested Activities:

- Flipped classroom on casual and statistical dependence.
- Perform sample calculation of different inference models manually.

Suggested Evaluation Methods:

- Quiz on statistical dependence
- Practical – Automation of the mathematical functions through WebPPL.
- Practical - Programming assignments on analyzing data through cognitive models with webPPL.
- Evaluation of the programming assignments.

UNIT V IMPLEMENTING THE LEARNING MODELS OF COGNITION 9

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's Razor– Learning (Deep) Continuous Functions – Mixture Models.

Suggested Activities:

- Flipped classroom on Mixture models.
- Perform sample calculation of models manually.

Suggested Evaluation Methods:

- Quiz on Mixture models.

- Practical – Automation of the mathematical functions through WebPPL.
- Practical - Programming assignment on learning models for continuous functions.
- Evaluation of the programming assignments.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand the underlying theory behind cognition.
2. Connect to the cognition elements computationally.
3. Implement mathematical functions through WebPPL.
4. Develop a cognitive inference model.
5. Develop a cognitive learning model.
6. Explore the recent trends in cognitive computing.

REFERENCES:

1. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”, The MIT Press, 1999.
2. Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/.
3. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.

CA5035	MIDDLEWARE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a sound knowledge in various middleware technologies
- To understand the middleware usage in distributed environment
- To gain the knowledge about RMI, CORBA and EJB
- To understand the development of web applications using SOAP and other web services
- To familiarize between various web service architectures and their standards
- To provide the knowledge to develop middle ware application for real time usage

UNIT I INTRODUCTION **9**

General Middleware, Service Specific Middleware, Client/Server Building blocks – RPC - Messaging – Peer – to – Peer, Java RMI - Computing standards – OMG - Overview of CORBA - Overview of COM/DCOM - Overview of EJB - Middleware types - Middleware in distributed Applications.

Suggested Activities:

- Development of distributed applications using RMI.
- Development of synchronous and asynchronous Java based Messaging Services.

Suggested Evaluation Methods:

- Quiz on RMI and distributed services.
- Demonstration of RMI and web services implementation.

UNIT II EJB and CORBA **9**

EJB architecture - Overview of EJB software architecture, EJB Conversation, Building and Deploying EJBs, Roles, applications - EJB Session Beans, EJB entity beans - Lifecycle of Beans - EJB clients - developing an application - Deployment. CORBA – components - Architectural features - method invocations - static and dynamic: IDL - CORBA's self-describing data - interface repository - Building an application using CORBA - Overview of CORBA Services - Object location Services, Messaging Services - CORBA Component Model.

Attested

Suggested Activities:

- Development of distributed applications using CORBA and Java Bean.

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- Development of services using EJB.

Suggested Evaluation Methods:

- Quiz on CORBA and EJB based web services.
- Demonstration of EJB and CORBA web services implementation.

UNIT III COM and .NET 9

Evolution of DCOM - Introduction to COM - COM clients and servers - COM IDL - COM Interfaces COM Threading Models – Marshalling - Custom and standard marshalling - Comparison COM and CORBA - Introduction to .NET - Overview of .NET architecture - Remoting.

Suggested Activities:

- Developing applications using COM and .NET.
- Flipped classroom on web services with .NET.

Suggested Evaluation Methods:

- Quiz on COM and .NET services.
- Demonstration of COM based web application using .NET.

UNIT IV SOA and WEB SERVICES 9

Defining SOA - Business value of SOA - SOA characteristics - Concept of a service, Basic SOA - Enterprise Service Bus (ESB) - SOA enterprise Software Models -Services and SOA – WSDL - SOAP, UDDI, WS Standards -Web Services and Service Oriented Enterprise (SOE) - Coordination and Transaction - Business Process Execution Language for Web Services.

Suggested Activities:

- Creation of a SOAP and RESTful based web services.
- Creation of services using UDDI and WSDL

Suggested Evaluation Methods:

- Assignment on various Case studies to SOA applications.
  Demonstrations on the applications developed and its comparison.

UNIT V OTHER TYPES OF MIDDLEWARE

Other types of Middleware, Real-Time Middleware, Embedded Systems Middleware, Mobile Middleware, Oracle Fusion Middleware.

Suggested Activities:

- Analysis of the applications of various Middleware.
- Creation of any web based middleware application.

Suggested Evaluation Methods:

- Assignment on case studies of various Middleware applications.
- Demonstration of the web based middleware applications and its comparison

TOTAL: 45 PERIODS

OUTCOMES:

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

1. To implement the distributed services using RMI and CORBA
2. To implement programs in EJB
3. To map and differentiate the functions between COM and .NET
4. To outline the functionalities of various types of middleware technologies
5. To design web services using SOAP, UDDI, WSDL
6. To design the middleware applications for real time usage.

REFERENCES:

1. G. Sudha Sadasivam, Radha Shankarmani, “Middleware and Enterprise Integration Technologies”, Wiley, 2009.

2. Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju, “Web Services: Concepts, Architectures and Applications”, Springer, 2010.
3. Ian Gorton, “Essential Software Architecture”, Springer, 2nd Edition, 2011.
4. Judith M. Myerson, “The Complete Book of Middleware” Auerbach Publications, 1 edition, 2002.
5. SasuTarkoma, “Mobile Middleware: Supporting Applications and Services” Wiley 1st edition, 2009.
6. Distributed Systems Architecture: A Middleware Approach”, Morgan Kaufmann, 2005.
7. Reza Shafii, Stephen Lee, and Gangadhar Konduri, “Oracle Fusion Middleware 11g Architecture and Management”, McGraw-Hill Osborne Media, 1 edition, 2011.

CA5036	UI & UX	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I FOUNDATIONS OF DESIGN 9

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy

Suggested Activities:

- Hands on Design Thinking process for a product
- Brainstorming features for a product

Suggested Evaluation Methods:

- Evaluate final product of design thinking
- Evaluate result for a product

UNIT II FOUNDATIONS OF UI DESIGN 9

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides

Suggested Activities:

- Defining the Look and Feel of any new Project
- Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)

Suggested Evaluation Methods:

- Evaluate the designs based on UI principles

UNIT III FOUNDATIONS OF UX DESIGN 9

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals

Suggested Activities

- Identify a customer problem to solve - Main Project start 1

Suggested Evaluation Methods

- Customer problem statement should match any of the main problem faced in real time

UNIT IV RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE 9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture

Suggested Activities

- Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping - Main Project continues 2

Suggested Evaluation Methods

- Evaluate the user research by user story and scenarios

UNIT V WIREFRAMING, PROTOTYPING AND TESTING 9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration

Suggested Activities

- Sketch, design and build a prototype and perform usability testing and identify improvements - Main project ends 3

Suggested Evaluation Methods

- Evaluate wireframe by usability
- Evaluate prototype by UI principles and usability

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

1. Build UI for user Applications
2. Know the UI Interaction behaviors and principles
3. Evaluate UX design of any product or application
4. Demonstrate UX Skills in product development
5. Implement Sketching principles
6. Create Wireframe and Prototype

REFERENCES:

1. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3. https://www.nngroup.com/articles/
4. https://www.interaction-design.org/literature

CA5037	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand Basic Programming concepts and the underlying logic/structure
- To Describe RPA, where it can be applied and how its implemented
- To Describe the different types of variables, Control Flow, and data manipulation techniques
- To Understand Image, Text, and Data Tables Automation
- To Describe automation to Email and various types of Exceptions and strategies to handle

UNIT I RPA CONCEPTS 10

RPA Basics - History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA

Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document - Industries best suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.

Suggested Activities

- See an RPA solution in production
- Analyse a case study for RPA and its lifecycle
- Compare tools and know the differences
- Identify companies using RPA solution and discuss the use cases

Suggested Evaluation Methods

- Build a use case for RPA and its lifecycle
- Difference between RPA and Test Automation
- Components Understanding
- Architecture Understanding
- Tools Differentiation
- Difference between RPA and AI

UNIT II RPA TOOL INTRODUCTION & BASICS 11

Introduction to RPA Tool - The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation - Data Manipulation Introduction - Scalar variables, collections and Tables - Text Manipulation - Data Manipulation - Gathering and Assembling Data

Suggested Activities

- Implement Variables, Data Types and Control Flow
- Apply Data Manipulation techniques

Suggested Evaluation Methods

- Building scenarios to apply learning from this unit

UNIT III AUTOMATION CONCEPTS INTRODUCTION 10

Recording and Advanced UI Interaction - Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors

Suggested Activities

- Implement Recording and UI Interactions
- Implement Selectors and Keyboard based automation

Suggested Evaluation Methods

- Building scenarios to apply learning from this unit

UNIT IV ADVANCED AUTOMATION CONCEPTS AND TECHNIQUES 10

RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation - Information Retrieval - Advanced Citrix Automation challenges - Best Practices - Using tab for Images - Starting Apps - Excel Data Tables & PDF - Data Tables in RPA - Excel and Data Table basics - Data Manipulation in excel - Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF.

Suggested Activities

- Implement Recording and UI Interactions
- Implement Selectors and Keyboard based automation
- Implement Scrapping techniques

Suggested Evaluation Methods

- Building scenarios to apply learning from this unit

UNIT V EMAIL AUTOMATION & EXCEPTIONAL HANDLING 6

Email Automation - Email Automation - Incoming Email automation - Sending Email automation - Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.

Suggested Activities

- Create and Debug errors in the workflow
- Read and extract content from PDF, Email
- Develop a fully functional Bot and share it with others

Suggested Evaluation Methods

- Building a fully functional Bot for an UseCase

TOTAL: 45 PERIODS

OUTCOMES

On Completion of the course, the students should be able to:

1. Understand the need and use of Automation
2. Describe RPA, where it can be applied and how its implemented
3. Describe the different types of variables, Control Flow, and data manipulation techniques
4. Identify and understand Image, Text, and Data Tables Automation
5. Describe automation to Email and various types of Exceptions and strategies to handle
6. Build Bots which can do automation

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2. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: A Primer, Institute of Robotic Process Automation”, 2015.
3. Richard Murdoch, “Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant”, 2018.
4. Srikanth Merianda, “Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”, 2018
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CA5038	SOFTWARE DESIGN PRINCIPLES & ARCHITECTURE PATTERNS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about various software development lifecycle (SDLC) models, software development techniques and its application in real world context.
- To understand process, process improvement, requirements engineering and requirements management.
- To be aware of designing a software considering the various perspectives of end user. To learn to develop a software component using coding standards and facilitate code reuse.
- To use advanced software testing techniques.
- To analyze the software using metrics and to predict the complexity and the risk associated with projects.

UNIT I FORMAL METHODS AND AGILE METHODOLOGIES 9

Software and Software Engineering – Software Process Models – Process Activities – The Rational Unified Process – Agile Development – Agile Software – Process Improvement – Software Quality Methodologies.

Suggested Activities:

- Identify and propose ways to build quality software to stop deterioration due to change.
- Assignments like the following: Giving reasons for your answer based on the type of system being developed, suggest the most appropriate generic software process model that might be used as a basis for managing the development of the following systems (not limited to):
  - A system to control anti-lock braking in a car.
  - A virtual reality system to support software maintenance.
  - A university accounting system that replaces an existing system.
  - An interactive travel planning system that helps users plan journeys with the lowest environment impact.
- Using the FDD feature template, define a feature set for a web browser.

Suggested Evaluation Methods:

- Assignments on the selection of suitable software process models for a given software specification.
- Tutorial – Identification of sample application for each process model and justification of the same stating reasons.

UNIT II REQUIREMENTS ENGINEERING AND MANAGEMENT 9

Requirements Engineering – Requirements Elicitation – Analysis and Negotiation – Requirements Modelling and Specification – Requirements Validation and Management – Requirements Engineering Process Models.

Suggested Activities:

- External Learning – Using open-source tools for RE to understand the requirements traceability and interdependency among the functionalities provided by the software project.
- External Learning – Requirements elicitation mechanisms and selection of an appropriate strategy.

Suggested Evaluation Methods:

- Tutorial on various Requirements Elicitation mechanisms and selection of an appropriate strategy.
- Assignment on Requirements Categorization (considering contradicting, omission, commission of requirements) in a software project.
- Assignment on Selection of suitable software process models for a given software specification.

UNIT III SOFTWARE DESIGN, OOAD AND SOFTWARE IMPLEMENTATION 9

Component Based and Model-Driven Development – Design Methods: Procedural and Structural Design Methods, Object Oriented Design Method, UML User-centred Design - Characteristics of Users - Basics of user interface design -Usability Principles - Evaluating User Interfaces, Modeling Interactions and Behaviour: Interaction Diagrams - State Diagrams - Activity Diagrams - Implementing Classes based on Interaction and State Diagrams - Difficulties and Risks in Modeling Interactions and Behaviour. Advance Use Cases.

Suggested Activities:

- Design and model for any project (Software Project Categories – PHP Projects, Data Mining, Android Projects, Smart Card/ Biometrics, Dotnet Projects, Web Based Projects, Information Security, Ios Projects, Artificial Intelligence, Embedded Projects).
- Draw the activity network representation of the tasks.
- Determine ES, EF, and LS, LF for every task.
- Develop the Gantt chart representation for the project.

Suggested Evaluation Methods:

- Assignments on Software Design and modelling.
- Tutorial problems on UML Modelling.
- Quiz on Software Design methods and its implementation.

UNIT IV SOFTWARE PRACTICES, PROCESSES AND ARCHITECTURE 9

Software Engineering Practices – Essence – Core Principles – Communication Practice – Planning Practice – General Structure of a Process – Process Framework – Process Improvements – Software Development Methodologies – Object Oriented Development Process – Unified Process – RAD Model – Software Testing.

Suggested Activities:

- In-class activity on application specific product and process view.
- Develop a complete process framework for any project like healthcare system.
- A class project may be given as follows: Develop a debugging plan that will provide language and system-oriented hints that have been learnt. Begin with the outline of topics that will be revived by the class and your instructor. Publish the debugging plan for others in your local environment.

Suggested Evaluation Methods:

- Assignment on testing sample application and understand the differences in selecting of test cases from the test suite.
- Tutorial problems on software development methodologies.
- Quiz on software development methodologies and software engineering practices.

UNIT V SOFTWARE PROJECT MANAGEMENT 9

Real-time Software Design – Real-time Requirement specification – Design Guidelines for Real-time Software – Scheduling Concepts – Testing Real-time Software, Risk Management, Planning and Scheduling – Configuration Management – Software Quality Management – Software Metrics.

Suggested Activities:

- Perform software project management for any project like automobile in which the driver commands the steering wheel and provides vision.
- Develop a schedule timeline.
- Develop Mini projects (Software Project Categories – PHP Projects, Data Mining, Android Projects, Smart Card/ Biometrics, Dotnet Projects, Web Based Projects, Information Security, IOS Projects, Artificial Intelligence, Embedded Projects)

Suggested Evaluation Methods:

- Assignment on testing sample application and understanding the differences in the selection of test cases from the test suite.
- Tutorial problems on risk management, configuration management, quality management, planning and scheduling.
- Quiz on risk management, configuration management, quality management, planning and scheduling.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Analytically apply general principles of software development in the development of complex software and software- intensive systems.
2. Understand methods and techniques for advanced software development and also be able to use these in various development situations.
3. Apply testing techniques for object-oriented software and web-based systems.
4. Familiarize with the basic concepts of Software design and implementation.
5. Apply various software metrics on software quality products.
6. Apply various skills on real-time projects.

Attested

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REFERENCES:

1. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Seventh Edition, Tata McGraw-Hill, 2009.
2. Ian Sommerville, “Software engineering”, Ninth Edition, Pearson Education, 2010.
3. S. A. Kelkar, “Software Engineering A Concise Study”, PHI Learning, 2010.
4. Ali Behforooz, Frederick J. Hudson, “Software Engineering Fundamentals”, Oxford University, 1996.
5. Timothy C Lethbridge, Object-Oriented Software Engineering Practical Software Development using UML and Java, 2 edition, McGraw-Hill Higher Education, 2005.
6. Object-Oriented Software Engineering: A Use Case Driven Approach, Addison Wesley Longman Publishing Co., first edition, 2004.

CA5039	AUTONOMOUS GROUND VEHICLE AND UNMANNED AERIAL VEHICLE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of autonomous driving.
- To study the different ways of sensing internal states of Autonomous Ground Vehicles (AGVs).
- To learn the environment perception for autonomous driving.
- To describe the role of Unmanned Aerial Vehicles (UAVs) Drones system.
- To understand and describe basic regulations applicable to UAV flight.

UNIT I INTRODUCTION TO AUTONOMOUS DRIVING 9

Autonomous Driving Technologies Overview – Autonomous Driving Algorithms – Autonomous Driving Client System – Autonomous Driving Cloud Platform – Components of Autonomy – Difference between Unmanned and Autonomous Vehicles – Introduction to Unmanned Aerial Vehicles (UAVs).

Suggested Activities:

- Flipped classroom on autonomous driving system architecture.
- External learning - Building blocks of typical Unmanned Aerial Vehicles.
- Flipped classroom on robot Operating System.
- External learning - Applications of autonomous vehicles (aerial, under water, ground vehicles).
- Assignment on the design requirement specifications of autonomous vehicles (aerial, under water, ground vehicles).

Suggested Evaluation Methods:

- Viva voce on assignment topics.
- Quizzes on Advanced Driver Assistance Systems (ADAS).
- Group Discussion on Google's self-driving car.

UNIT II SENSORS FOR AUTONOMOUS GROUND VEHICLES 9

Sensor Characteristics –Vehicle Internal State Sensing: OEM Vehicle Sensors, GPS, Inertial Measurements, Magnetometer – External World Sensing: RADAR, Lidar, Image Processing Sensors.

Suggested Activities:

- Flipped Classroom on sensor characteristics.
- External learning - Working principle of IMU/GPS/RADAR sensors.
- External learning - Exploring Velodyne Lidar sensor dataset in Veloview software.

Attested

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Suggested Evaluation Methods:

- Practical - Experiments on interfacing IMU sensor to Raspberry Pi board and recording the acceleration of a dummy vehicle.
- Practical - Experiments on interfacing Lidar/RADAR sensor to Raspberry Pi board and recording the distances to the nearby objects.
- Practical - Experiments on interfacing camera to Raspberry Pi board and capturing images/videos.

UNIT III ENVIRONMENT PERCEPTION AND MODELING 9

Road Recognition: Basic Mean Shift Algorithm, Mean Shift Clustering, Mean Shift Segmentation, Mean Shift Tracking, Road Recognition Algorithm –Vehicle Detection and Tracking: Generating ROIs, Multi Resolution Vehicle Hypothesis, Vehicle Validation using Gabor Features and SVM, Boosted Gabor Features – Multiple Sensor Based Multiple Object Tracking.

Suggested Activities:

- Flipped classroom on basic mean shift algorithm.
- External learning - Lane detection algorithm.
- Flipped classroom on vehicle tracking.

Suggested Evaluation Methods:

- Practical - Implementation of Mean Shift Clustering / Mean Shift Segmentation Algorithm.
- Practical - Experiments on stationary obstacle detection algorithm using Lidar sensor.

UNIT IV OVERVIEW OF UNMANNED AERIAL VEHICLES 9

Introduction – History of UAVs – Classification: Scale, Lift Generation Method – Applications: Military, Government and Civil – Operational Consideration: Legal issues, Ethical Implications, Human Factors, LOS – Regulatories: Homeland (FCC, FAA) and Foreign Regulatories – Regulations: Federal Aircraft Regulations (FARs).

Suggested Activities:

- Flipped classroom on categories of Drones.
- External learning – Team Daksha from MIT.
- Assignment on the working principles of various Drones.

Suggested Evaluation Methods:

- Quizzes on policies for using UAVs in Home and Foreign Regularities.
- Viva Voce on assignment topics.
- Practical – Safety consideration of flying Drones.

UNIT V METHODOLOGIES IN FLYING UAVs 9

Propulsion: Internal Combustion, Turbine and Electric Engines – On-board Flight control – Payloads: Sensing, Surveillance and Delivery – Communications: Command, Telemetry and Ground Control Stations – Aerodynamics: Lift, Weight and Drag – Flight Performance: Climbing, Gliding and Range Endurance – Stability and Control: Flight Axes and Controls, Autopilots.

Suggested Activities:

- Flipped classroom on UAVs flight control.
- External learning - Study on ground station control in airports.
- Assignment - Communication protocols for UAVs.

Suggested Evaluation Methods:

- Viva Voce on assignment topic.
- Practical - Experiment on simple axes controls.
- Practical - Experiment on sensing and surveillance.

Attested

TOTAL: 45 PERIODS

OUTCOMES:

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

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1. Identify the requirements and design challenges of AGVs.
2. Select suitable sensors to sense the internal state and external world of AGVs.
3. Implement lane detection, road detection & vehicle detection algorithms.
4. Know about the policies in flying UAVs.
5. Ethics in using UAVs according to regulations.
6. Design communication protocols for UAVs from ground stations controls.

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1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems", Morgan & Claypool, 2018.
2. UmitOzguner, TankutAcarman, Keith Redmill, "Autonomous Ground Vehicles", Artech House, 2011.
3. A. R. Jha, "Theory, design and applications of Unmanned Aerial Vehicles", 2016.
4. Hong Cheng, "Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation", Springer, 2011.
5. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, "Global Navigation Satellite Systems, Inertial Navigation, and Integration", Third Edition, John Wiley & Sons, 2013.

CA5040	FINANCIAL TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of the financial technologies, and Investment analysis
- To study the different ways of raising money with Fintech
- To learn how to harness data with artificial intelligence and machine learning
- To understand and describe the digital finance and alternative finance and the future of Fintech.
- Developing the capability in terms of the applications of tools and techniques in analyzing and solving problems related to investment

UNIT I FINTECH 9

Reshaping the Banking and Payments Industry -Analyse the Source of Banks' vulnerability FinTech Transformation, FinTech Evolution 1.0,2.0,3.0,3.5, Collaboration between Financial Institutions and Startups, FinTech Typology, Emerging Economics: Opportunities and Challenges.

Suggested Activities:

- Flipped classroom on basics of FinTech Typology.
- External learning - The future of RegTech and the Technologies impacting it.

Suggested Evaluation Methods:

- Quizzes on FinTech.
- Assignments on Emerging Economics.

UNIT II INNOVATIONS OF FINTECH 9

Conclude whether the disintermediation of banks in the provision of credit is a transitory or permanent phenomenon. Individual Payments, Mobile Money, Regulation of Mobile Money, RTGS Systems, ABCDs of Alternative Finance, Building a New stack Cryptocurrencies, Legal and Regulatory Implications of Cryptocurrencies, Blockchain, The Benefits from New Payment Stacks (Applications of Ripple)

Suggested Activities:

- Flipped classroom on basics of Mobile Money.
- External learning - Legal and Regulatory Implications of Cryptocurrencies

Suggested Evaluation Methods:

- Quizzes on ABCDs of Alternative Finance.
- Demonstration of the practical implementations of Blockchains.

Attested

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UNIT III FINTECH REGULATIONS AND DATA REGULATION 9

FinTech Regulations - Evolution of RegTech - RegTech Ecosystem: Financial Institutions, Startups, Challenges, Regulators, Regulatory Sandboxes, Smart Regulation. Data Regulation Data in Financial Services-European Big-Bang: PSD2 / GDPR / MiFID2 – Digital Identity- Regulation 1.0 to 2.0 (KYC to KYD)

Suggested Activities:

- Flipped classroom on basics of data regulations of various countries.
- External learning - Transforming Personal Finance with Fintech
- External learning - Application of AI in Smart Regulation (Mindbridge)
- Read: Dhar, V., Robots Will Soon Do Your Taxes: Bye Bye Accounting Jobs, Wired, Feb 2017 https://www.wired.com/2017/02/robots-will-soon-taxes-bye-byeaccounting-jobs/
- Read: https://www.predictiveanalyticstoday.com/artificial-intelligence-platforms/

Suggested Evaluation Methods:

- Quizzes on FinTech Regulations.
- Assignments on automation in the investment management industry, Balancing Innovation and Regulation Challenges.
- Industry Showcase: Cybersecurity Industry, PSD2: Open Banking API for Startups (Gini), Application of Data Analytics in Finance.

UNIT IV DIGITAL FINANCE AND ALTERNATIVE FINANCE 9

History of Financial Innovation, Digitization of Financial Services, FinTech & Funds – Method of AI used to Transform the Future of FinTech, Ensuring Compliance from the Start: Suitability and Funds, Crowdfunding - Regards, Charity and Equity,P2P and Marketplace Lending, The Rise of new TechFins - New Models and New Products

Suggested Activities:

- Flipped classroom on basics of Digitization of Financial Services.
- External learning - Ensuring Compliance from the Start

Suggested Evaluation Methods:

- Quizzes on Financial Innovation.
- Assignments on Method of AI used to Transform the Future of FinTech.

UNIT V BUILDING & MANAGING A SUCCESSFUL FINTECH STARTUP 9

Understanding the impact of Macro & Micro factors on the Business Dynamics- Art & Science of Design Thinking Managing Growth, Fund Raising and Exits. Disruptive Technology Cases in FinTech

Suggested Activities:

- Flipped classroom on basics of TechFin.
- External learning – How is FinTech reconfiguring financial services business models? What are the key disruption points? What determines success in FinTech?
- External learning – Where are the limits, risks, and broader policy and social implications of FinTech?

Suggested Evaluation Methods:

- Assignments on automation in the investment management industry.
- Case Studies- Revolut, Alibaba, Aadhaar, Credit Karma, Digibank.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Apply the concepts and computational basics in the real-world financial market scenario
2. Formulate trading strategies by identifying the patterns in trading and market price movements
3. Evaluate portfolios through systematic technical and fundamental analysis

4. Collaborate and compete with trading groups in a simulated environment and extend to the real investment scenarios
5. Demonstrate decision dynamics to attain the investment objectives in a stock market environment
6. Learn to assess the future of fintech and think strategically about challenges faced by financial companies

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1. Jutla, S. – Sundararajan, N.,"India's FinTech Ecosystem. In: The FinTech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries", 2016
2. John Hill, Fintech and the Remaking of Financial Institutions, Elsevier Publication, 1st Edition ISBN: 978- 0128-134-979, 2018
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5. Bhandari, M. India and the Pyramid of Opportunity. In: The FinTech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, 2016.

CA5041	LINUX ADMINISTRATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explore the commands for accessing hardware resources
- To learn the concepts of Linux file systems
- To understand the working of boot process, kernel, and user spaces
- To explore different process and memory management tasks
- To familiarize the network configuration files

UNIT I INTRODUCTION **9**

Levels and Layers of Abstraction in a Linux System – Hardware – Kernel: Process Management, Memory Management, Device Drivers and Management, System Calls and Support – User Space – Shell Commands

Suggested Activities

- Flipped classroom on internals of any Operating System
- In class activity - overall view of Linux installation

Suggested Evaluation Methods

- Quizzes
- Programming assignments on shell commands

UNIT II DEVICES, DISKS and FILE SYSTEMS **9**

Device Files – Device Path – Device Name Summary – udev – SCSI and Linux Kernel – Partitioning Disk Devices – Filesystems – Swap Space

Suggested Activities

- Flipped classroom on various devices
- In class activity - Exploring the devices through commands in Linux environment

Suggested Evaluation Methods

- Quizzes
- Analysis of the device usage
- Programming with shell commands to understand the usage of various devices

UNIT III KERNEL SPACE AND USER SPACE **9**

How the Linux Kernel Boots: Startup messages – Kernel initialization and Boot options – Kernel

Parameters – Bootloaders – GRUB – UEFI – Chainloading other operating systems – How the User space starts: Introduction to Init – System V Runlevels – systemd – Upstart – System V init – Shutting down the System – Initial RAM Filesystem – Emergency booting and Single-User modeling

Suggested Activities

- Flipped classroom on the booting methods and file systems
- In class activity - Exploring the location and function of bootloaders in Linux

Suggested Evaluation Methods

- Quizzes
- Dual boot using GRUB
- Exploring bootloader commands

UNIT IV SYSTEM CONFIGURATION, PROCESS AND RESOURCE UTILIZATION 9

Structure of etc – System Logging – User Management Files – Time – Scheduling Tasks with cron and at – Identification and Authentication – Process and Resource Utilization: Tracking Processes – lsof – Tracing Program Execution and System Calls – Threads – Measuring CPU Time – Adjusting Process Priorities – Load Averages – Memory – I/0 Monitoring

Suggested Activities

- Flipped classroom on the types of logs and CPU/ memory management
- In class activity - Exploring the usage of CPU and memory through commands

Suggested Evaluation Methods

- Quizzes
- Time analysis to process different types of programs
- Memory usage analysis for different process using shell commands

UNIT V NETWORK CONFIGURATION AND SERVICES 9

Network basics – Network Layers – Routes and Kernel Routing table – Basic ICMP and DNS tools – Physical Layer and Ethernet – Kernel Network Interfaces – NIC configuration – Resolving Hostname – Localhost – Transport layer: TCP, UDP and Services – Revisiting a Simple Local Network – Understanding DHCP – Configuring Linux as a Router – Firewalls – Ethernet, IP and ARP - Wireless Ethernet – Secure Shell ssh – Diagnostic Tools

Suggested Activities

- Flipped classroom on network concepts
- In class activity - Exploring the network details through commands

Suggested Evaluation Methods

- Quizzes
- Editing configuration files for different network setup
- Usage of different ssh commands to access a remote machine

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand an overall view of the structure of Linux
2. Access the different devices through commands
3. Work with kernel and user spaces in Linux environment
4. Automate tasks using scheduling tools
5. Configure network files based on the specific need
6. Acquire Linux Administration skills to manage a server

REFERENCES:

1. Brian Ward, How Linux Works – what every superuser should know, Second edition No starch press, 2015.
2. https://developer.ibm.com/technologies/linux/

CA5042	VOICE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of the speech processing
- Explore the various speech models
- Gather knowledge about the phonetics and pronunciation processing
- Perform wavelet analysis of speech
- To understand the concepts of speech recognition

UNIT I VOICE COMPUTING 9

Fundamentals of Voice Computing – History of Voice Computing – Reading and Writing of Audio files – Microphone – Mixers – Recording – Text to Speech Systems

Suggested Activities:

- Flipped classroom on basics of voice computing.
- External learning - mixers
- Practical - Implementation of any one application of Text to Speech systems.

Suggested Evaluation Methods:

- Quizzes on voice computing.
- Assignments on Reading and writing of audio files.
- Demonstration of the practical implementations of Text to Speech systems.

UNIT II FEATURES 9

Features – Audio features – Mixed Features – Dimensionality Reduction - Speech Recognition - Automatic Speech Recognition – Architecture – Applying Hidden Markov Model – Feature Extraction: mfcc Vectors – Computing Acoustic Likelihoods

Suggested Activities:

- Flipped classroom on basics of features.
- External learning - Automatic speech recognition

Suggested Evaluation Methods:

- Quizzes on features.
- Assignments on Dimensionality Reduction.
- Demonstration of the practical implementations of Automatic speech recognition.

UNIT III MODELING 9

Classification and Regression models – Classification of Speaker Gender - Visualizations - Speech Modelling, Word Classes and Part Of Speech Tagging – Hidden Markov Model – Computing Likelihood: Forward Algorithm – Training Hidden Markov Model - Speech Pronunciation and Signal Processing, Phonetics – Speech Sounds and Phonetic Transcription – Articulatory Phonetics - Phonological Categories and Pronunciation Variation

Suggested Activities:

- Flipped classroom on basics of Classification and Regression models.
- External learning - Speech Modelling
- Practical - Implementation of any one application of Phonetics.

Suggested Evaluation Methods:

- Quizzes on Classification and Regression models.

- Assignments on Classification and Regression models.

UNIT IV MACHINE VOICE 9

Generation of Machine Voice– Generating Text – Speech to Text and Text to Speech Systems - Audio- Acoustic Models – Context -Dependent Acoustic Models: Triphones – Discriminative Training – Speech Recognition by Humans

Suggested Activities:

- Flipped classroom on basics of Speech to text and Text to Speech systems.
- External learning - speech recognition by humans

Suggested Evaluation Methods:

- Quizzes on acoustic models.
- Assignments on Speech to text and Text to Speech systems.
- Demonstration of the practical implementations.

UNIT V VOICE USER INTERFACE 9

Designing for Voice UI – Anatomy of Voice Command, Building Call-and-Response – Interaction Model for Alexa, Designing Voice User Interface- Making Conversations – Speech Synthesis Mark-Up Language- Directing Conversation Flow – Building Google Assistant – Case Study -Apple(Siri), Microsoft(Cortana), Amazon(Alexa).

Suggested Activities:

- Flipped classroom.
- Practical - Building Google Assistant

Suggested Evaluation Methods:

- Quizzes on Voice UI.
- Assignments on Speech synthesis Mark-up Language.
- Demonstration of the practical implementations of Voice user Interface.

TOTAL:45 PERIODS

OUTCOMES:

On Successful completion of the course, Students will be able to

1. Understand the basics of Voice computing
2. Derive Features form audio, speech, and voice.
3. Understand the need for machine learning and basic of HMM models
4. Understand the need for speech identification system
5. Generate a new speech recognition system
6. Gain a knowledge of Voice applications for Alexa and Google Assistant

REFERENCES:

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Person education,2013.
2. Jim Schwoebel, An Introduction to Voice Computing in Python, NeuroLex Laboratories Inc, 2018.
3. Dustin A. Coates, Voice Applications for Alexa and Google Assistant, Manning Publications, 2019.
4. Kai-Fu Lee, Automatic Speech Recognition, The Springer International Series in Engineering and Computer Science, 1999.
5. Ikrami Eldirawy, Wesam Ashour, Visual Speech Recognition, Wiley publications, 2011

CA5043	BUSINESS DOMAINS AND VERTICALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposed to the concepts of Business Domains and verticals.
- To understand the concepts in the manufacturing & service sector
- To portray the modern retailing.
- To develop a conceptual and analytical understanding of the information systems.
- To understand the concepts of Portfolio Theory aand Practice

UNIT I BUSINESS DOMAINS & VERTICALS 9

Concept of Business Domain - Manufacturing, Finance, Human Resource, Marketing, Information Technology, Service- Business Verticals - Management Process - Study of Business Domain with respect to mission, incorporation, organization

Suggested Activities:

- Flipped classroom on basics of Business Domains.
- External learning - Business domain with respect to mission, incorporation, organization
- Practical - Implementation of any one prototype of one verticals.

Suggested Evaluation Methods:

- Quizzes on various domains.
- Case study on business domains and verticals.

UNIT II MANUFACTURING & SERVICE SECTOR 9

Overview of Operations Management Function - Overview of Finance Function - Overview of HRM Function - Overview of Marketing Function - Service Sector & Manufacturing Sector Difference

Suggested Activities:

- Flipped classroom on basics of service sector.
- External learning - HRM and marketing Function
- Practical - Implementation of any one application of Service Sector.

Suggested Evaluation Methods:

- Explore the analytical applications to Manufacturing and service sector.
- Case study on ICT for the service sector.

UNIT III MODERN RETAILING 9

Role of Analytics in Retail sector – Retail Analytics Framework - Retailing Marketplace, Market space and Understanding Technological Aspects - Overview on R/R-Studio - Data access and Basic Analysis using R

Suggested Activities:

- Flipped classroom on basics of Retail Analytics.
- External learning – Role of Analytics in Retail sector
- Practical - Implementation of any one application of - Data access and basic analysis using R

Suggested Evaluation Methods:

- Quizzes on Retail Analytics.
- Assignments on Data access and basic analysis using R

UNIT IV INFORMATION SYSTEMS FOR BUSINESS 9

Enterprise Business Applications, Overviews of ERP, Supply Chain Management System, CRM, International Information Systems. Transaction Processing Systems, MIS, DSS, Analytics and Business Intelligence, Knowledge Management Systems.

Suggested Activities:

- Flipped classroom on basics of MIS.
- External learning - Analytics and Business Intelligence
- Practical - Implementation of any one application of Enterprise Business Applications.

Suggested Evaluation Methods:

- Quizzes on ERPs.
- Assignments on MIS.
- Demonstration of the practical implementations Analytics for various business domains.

UNIT V PORTFOLIO THEORY AND PRACTICE 9

Portfolio Management; Markowitz portfolio Theory; portfolio mathematics; portfolio return; portfolio risk; capital allocation; optimal risky portfolios; index models; Equity portfolio management strategies; Overview of style analysis; asset allocation strategies; Evaluation of Portfolio performance – Composite Portfolio Performance measures; Application of Portfolio performance measures; Evaluation of bond portfolio performance.

Suggested Activities:

- Flipped classroom on basics of Portfolio.
- External learning - portfolio return; portfolio risk; capital allocation; optimal risky portfolios
- Practical - Implementation of any one application of Portfolio performance measures.

Suggested Evaluation Methods:

- Quizzes on Portfolio Management.
- Assignments on the Evaluation of bond portfolio performance.
- Demonstration of the practical implementations.

TOTAL:45 PERIODS

OUTCOMES:

On Successful completion of the course, Students will be able to

1. Fundamentals of Business domains & verticals
2. Overview of manufacturing & service sector
3. Role of analytics in retail sector
4. Portfolio theory and practice
5. Importance of Information Systems as business support tool
6. Business domains with respect to their Mission, Incorporation, Organization, Operative functions, USP/Distinctive Services, Information Needs Analysis, Functional Flow Diagram, Critical Application Areas, Growth& Competitiveness etc.

REFERENCES:

1. De Rahul, “Managing Information Systems in Business, Government and Society”, Second Edition, Wiley India Pvt. Ltd, 2018
2. Ramesh Sharda, Dursun Delen and Efraim Turban, “Business Intelligence and Analytics: Systems for Decision Support”, Tenth edition, Pearson, 2018
3. Frank K. Reilly, Keith C. Brown, “Analysis of Investments & Management of Portfolios”, CENGAGE Learning, 2015.
4. Chandra Prasanna, Investment analysis and portfolio management. Tata McGraw – Hill Publications, 2008.

CA5044 DIGITAL FORENSICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an understanding Computer Forensics fundamental.
- To analyze various Computer Forensics Technologies.
- To identify methods for data recovery.
- To apply the methods for preservation of digital evidence.

- To learn about the types of attacks and remedial actions in the context of systems, networks, images and video.

UNIT I INCIDENT AND INCIDENT RESPONSE 9

Introduction to Security Threats: Introduction, Computer Crimes, Computer Threats and Intrusions, Telecommunication Fraud, Phishing , Identity Theft, Cyber Terrorism and Cyber War – Need for Security : Information Security, OS Security, Database Security, Software Development Security – Security Architecture – Introduction to Incident – Incident Response Methodology – Steps – Activities in Initial Response Phase after Detection of an Incident.

Suggested Activities:

- Survey of forensics tools such as WinHex, EnCase, FTK, or ProDiscover.
- External learning - Demonstrate some of the mechanisms used by malicious attackers as well as forensic experts to disrupt computer networks and manipulate information access.

Suggested Evaluation Methods:

- Demonstration on forensic tools
- Assignment on solving with sample cybercrime reports.

UNIT II FILE STORAGE AND DATA RECOVERY 9

File Systems: FAT, NTFS, NTFS – Encrypting File System – Forensic Analysis of File Systems – Storage Fundamentals-Initial Response and Volatile Data Collection from Windows System – Initial Response & Volatile Data Collection from UNIX System – Forensic Duplication – Tools –Discover of Electronic Evidence – Identification of Data – Reconstructing Past Events – Networks.

Suggested Activities:

- Flipped classroom and activity.
- External learning - Tools for data storage and access, bypassing filtered [blocked] ports, reviewing Internet activity, open source forensic tools for file storage and data recovery will be introduced.

Suggested Evaluation Methods:

- Total quantity of files recovered from the disk for reconstruction.
- Quiz on forensic analysis of file system.

UNIT III NETWORK AND EMAIL FORENSICS 9

Network Evidence – Types of Network Monitoring – Setting Up a Network Monitoring System – Network Data Analysis – Email Clients – Email Tracing – Internet Fraud – Spam Investigations Mobile Forensics – Subscriber Identity Module (SIM) Investigations – Wireless Device Investigations – PDA Investigations.

Suggested Activities:

- External learning - Familiarizing with Port Redirection tools: Quick 'n Easy FTP Server, FPIPE and FPORT.
- Practical - Study of the forensics tools.

Suggested Evaluation Methods:

- Demonstration of Port Redirection tools.
- Practical - Assessment of real-time problems like email analysis for tracing.

UNIT IV SYSTEM FORENSICS 9

Data Analysis: Analysis Methodology – Investigating Live Systems (Windows & Mac OS) – Hacking: Investigating Hacker Tools – Ethical Issues – Cybercrime. Forensic and Investigative tools – Forensic Equipment's for Evidence Collection – Post exploitation.

Suggested Activities:

- Demonstration of MD5Hash tool.
- Practical - IE Activity analysis.

Attested

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Suggested Evaluation Methods:

- Assignment on live windows and Linux investigation
- Quiz on ethical hacking.

UNIT V IMAGE AND VIDEO FORENSICS 9

Recognizing a Graphics File – Data Compression – Locating and Recovering Graphics Files – Identifying Unknown File Formats – Copyright Issues with Graphics – Fraud using Image and Video – Detection of Fraud in Images and Video.

Suggested Activities:

- External learning - Steganography.
- Practical – Install and use Steganalysis tool.

Suggested Evaluation Methods:

- Assignment on forgery detection in images.
- Quiz on locating and recovering Graphics files.

TOTAL:45 PERIODS

OUTCOMES:

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

1. Recognize attacks on systems.
2. Design a counterattack incident response and incident-response methodology.
3. Illustrate the methods for data recovery, evidence collection and data seizure.
4. Understand network and email attacks and forensic investigation with tools.
5. Use Forensic tools and collect evidence of a computer crime.
6. Analyze various image encryption/decryption, steganography, and fraud in image.

REFERENCES:

1. Kevin Mandia, T. Jason Luttgens, Matthew Pepe, “Incident Response and Computer Forensics”, Tata McGraw-Hill, 2014.
2. Bill Nelson, Amelia Philips, Christopher Stueart, “Guide to Computer Forensics and Investigations”, Cengage Learning, 2018.
3. John R. Vacca, “Computer Forensics”, Firewall Media, 2009.
4. Eoghan Casey, “Handbook of Computer Crime Investigation's Forensic Tools and Technology”, Academic Press, 2001.
5. Davide Cowen, “Computer Forensics: A Beginners Guide”, McGraw-Hill Education, 2011.
6. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, Auerbach Publications, 2014

OPEN ELECTIVE COURSES (OEC)

		L	T	P	C
OE5091	**BUSINESS DATA ANALYTICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

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

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

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

Suggested Activities:

- Case studies on applications involving Business Analytics.
- Converting real-time decision-making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

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

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

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

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real-time decision-making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

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

Attested

Suggested Activities:

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- Practical – Install and configure Hadoop.
- Practical – Use web-based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

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

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Identify the real-world business problems and model with analytical solutions.
2. Solve analytical problem with relevant mathematics background knowledge.
3. Convert any real-world decision-making problem to hypothesis and apply suitable statistical testing.
4. Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
5. Use open source frameworks for modeling and storing data.
6. Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

OE5092	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, Causes, Types, Results and Control, Mechanical and Electrical Hazards, Types, Causes and Preventive Steps/Procedure, Describe Salient Points of Factories Act 1948 for Health and Safety, Wash Rooms, Drinking Water Layouts, Light, Cleanliness, Fire, Guarding, Pressure Vessels, Etc, Safety Color Codes. Fire Prevention and Firefighting, Equipment and Methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and Aim of Maintenance Engineering- Primary and Secondary Functions and Responsibility of Maintenance Department- Types of Maintenance- Types and Applications of Tools Used for Maintenance-Maintenance Cost & Its Relation with Replacement Economy- Service Life of Equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- Types, Causes, Effects, Wear Reduction Methods, Lubricants-Types and Applications, Lubrication Methods, General Sketch, Working And Applications - Screw Down Grease Cup - Pressure Grease Gun - Splash Lubrication - Gravity Lubrication- Wick Feed Lubrication - Side Feed Lubrication- Ring Lubrication, Definition, Principle and Factors Affecting the Corrosion- Types of Corrosion - Corrosion Prevention Methods.

UNIT IV FAULT TRACING 9

Fault Tracing-Concept and Importance, Decision Tree Concept, Need and Applications, Sequence of Fault-Finding Activities, Show As Decision Tree, Draw Decision Tree for Problems In Machine Tools, Hydraulic, Pneumatic, Automotive, Thermal And Electrical Equipment's Like. Any one Machine Tools- Pump - Air Compressor- Internal Combustion Engine- Boiler- Electrical Motors- Types of Faults in Machine Tools and their General Causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic Inspection-Concept and Need, Degreasing, Cleaning and Repairing Schemes, Overhauling of Mechanical Components, Overhauling of Electrical Motor, Common Troubles and Remedies of Electric Motor, Repair Complexities and Its Use, Definition, Need, Steps and Advantages of Preventive Maintenance. Steps/Procedure for Periodic and Preventive Maintenance of: - Machine Tools- Pumps- Air Compressors- Diesel Generating (DG) Sets- Program and Schedule Of Preventive Maintenance Of Mechanical and Electrical Equipment- Advantages of Preventive Maintenance. Repair Cycle Concept and Importance

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Ability to summarize basics of industrial safety
2. Ability to describe fundamentals of maintenance engineering
3. Ability to explain wear and corrosion

4. Ability to illustrate fault tracing
5. Ability to identify preventive and periodic maintenance

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgraw Hill Publication, 1978.
2. Garg H P,MaintenanceEngineering, S.Chand and Company,1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition,2008

OE5093	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. To formulate linear programming problem and solve using graphical method.
2. To solve LPP using simplex method
3. To formulate and solve transportation, assignment problems
4. To solve project management problems
5. To solve scheduling problems

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010

5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Understand the costing concepts and their role in decision making
2. Understand the project management concepts and their various aspects in selection
3. Interpret costing concepts with project execution
4. Gain knowledge of costing techniques in service sector and various budgetary controltechniques
5. Become familiar with quantitative techniques in cost management

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheelerpublisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
2. Identify the various reinforcements used in composite materials.
3. Compare the manufacturing process of metal matrix composites.
4. Understand the manufacturing processes of polymer matrix composites.
5. Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and Characteristics of Composite Materials - Advantages and Application of Composites - Functional Requirements of Reinforcement and Matrix - Effect of Reinforcement (size, shape, distribution, volume fraction) on Overall Composite Performance.

UNIT II REINFORCEMENTS 9

Preparation- Layup, Curing, Properties and Applications of Glass Fibers, Carbon Fibers, Kevlar Fibers and Boron fibers - Properties and Applications of Whiskers, Particle Reinforcements - Mechanical Behavior of Composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress Conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State Diffusion Technique - Cladding – Hot Isostatic Pressing - Properties and Applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid Phase Sintering. Manufacturing of Carbon – Carbon Composites: Knitting, Braiding, Weaving - Properties and Applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding Compounds and Prepregs – Hand Layup Method – Autoclave Method – Filament Winding Method – Compression Moulding – Reaction Injection Moulding - Properties and Applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-Strength Ratio, Maximum Stress Criteria, Maximum Strain Criteria, Interacting Failure Criteria, Hygrothermal Failure. Laminate First Play Failure-Insight Strength; Laminate Strength-Ply Discount Truncated Maximum Strain Criterion; Strength Design Using Caplet Plots; Stress Concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Know the characteristics of composite materials and effect of reinforcement in composite materials.
2. Know the various reinforcements used in composite materials.
3. Understand the manufacturing processes of metal matrix composites.
4. Understand the manufacturing processes of polymer matrix composites.
5. Analyze the strength of composite materials.

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, WestGermany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 **WASTE TO ENERGY**

L	T	P	C
3	0	0	3

OBJECTIVES:

1. Interpret the various types of wastes from which energy can be generated
2. Develop knowledge on biomass pyrolysis process and its applications
3. Develop knowledge on various types of biomass gasifiers and their operations
4. Invent knowledge on biomass combustors and its applications on generating energy
5. Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of Waste as Fuel – Agro Based, Forest Residue, Industrial Waste - MSW – Conversion Devices – Incinerators, Gasifiers, Digestors

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, Slow Fast – Manufacture of Charcoal – Methods - Yields and Application – Manufacture of Pyrolytic Oils and Gases, Yields and Applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed Bed System – Downdraft and Updraft Gasifiers – Fluidized Bed Gasifiers – Design, Construction and Operation – Gasifier Burner Arrangement for Thermal Heating – Gasifier Engine Arrangement and Electrical Power – Equilibrium and Kinetic Consideration in Gasifier Operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass Stoves – Improved Chullahs, Types, Some Exotic Designs, Fixed Bed Combustors, Types, Inclined Grate Combustors, Fluidized Bed Combustors, Design, Construction and Operation - Operation of all the above Biomass Combustors.

UNIT V BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste

to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

1. Understand the various types of wastes from which energy can be generated
2. Gain knowledge on biomass pyrolysis process and its applications
3. Develop knowledge on various types of biomass gasifiers and their operations
4. Gain knowledge on biomass combustors and its applications on generating energy
5. Understand the principles of bio-energy systems and their features

REFERENCES:

1. Biogas Technology - A Practical Handbook - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

AUDIT COURSES (AC)

		L	T	P	C
AX5091	**ENGLISH FOR RESEARCH PAPER WRITING**	**2**	**0**	**0**	**0**

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 Conclusions

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

OUTCOMES

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Understand the skills needed when writing the Conclusion
5. 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 book 1998.

AX5092 **DISASTER MANAGEMENT**

L	T	P	C
2	0	0	0

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 Epidemics

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.

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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

OUTCOMES

1. Ability to summarize basics of disaster
2. Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3. Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4. Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. 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", NewRoyal book Company,2007.
3. Sahni, Pardeepet. al.," Disaster Mitigation Experiences and Reflections", Prentice Hall ofIndia, New Delhi,2001.

AX5093 **SANSKRIT FOR TECHNICAL KNOWLEDGE**

L	T	P	C
2	0	0	0

OBJECTIVES

1. Illustrate the basic sanskrit language.
2. Recognize sanskrit, the scientific language in the world.
3. Appraise learning of sanskrit to improve brain functioning.
4. Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
5. Extract huge knowledge from ancient literature.

UNIT I ALPHABETS **6**

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES **6**

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS **6**

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE **6**

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING **6**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

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TOTAL: 30 PERIODS

OUTCOMES

1. Understanding basic Sanskrit language.
2. Write sentences.
3. Know the order and roots of Sanskrit.
4. Know about technical information about Sanskrit literature.
5. Understand the technical concepts of Engineering.

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

1. Understand value of education and self-development
2. Imbibe good values in students
3. Let they should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

1. Knowledge of self-development.
2. Learn the importance of Human values.
3. Developing the overall personality.

Suggested reading

1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford

University Press, New Delhi

AX5095	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
3. Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
4. To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization
3. of social reforms leading to revolution in India.
4. Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

5. Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

1. Review existing evidence on their view topic to inform programme design and policy
2. Making undertaken by the DFLD, other agencies and researchers.
3. Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework, and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research Questions - Overview of Methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical Practices are Being Used by Teachers in Formal and Informal Classrooms in Developing Countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic Theory and Pedagogical Approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional Development: Alignment with Classroom Practices and Follow up Support - Peer Support - Support from the Head Teacher and the Community - Curriculum and Assessment - Barriers to Learning Limited Resources and Large Class Sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research Design – Contexts – Pedagogy - Teacher Education - Curriculum and Assessment - Dissemination and Research Impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

1. What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Approved

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SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

1. To achieve overall health of body and mind
2. To overcome stress

UNIT I

Definitions of Eight parts of Yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha, ii) Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha.

UNIT III

Asan and Pranayam - Various Yoga Poses and their Benefits for Mind & Body - Regularization of Breathing Techniques and its effects-Types of Pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga Bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

Attested

OBJECTIVES

1. To learn to achieve the highest goal happily

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2. To become a person with stable mind, pleasing personality, and determination
3. To awaken wisdom in students

UNIT I

Neetisatakam-holistic Development of Personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to Day to Day Work and Duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of Basic Knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of Role Model - shrimadbhagwadgeeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda ,Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

BRIDGE COURSES (BC)

		L	T	P	C
MA5105	**MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce Mathematical Logic and their rules for validating arguments and programmes.
- To introduce counting principles for solving combinatorial problems.
- To give exposure to Graph models and their utility in connectivity problems.
- To introduce abstract notion of Algebraic structures for studying cryptographic and its related areas.
- To introduce Boolean algebra as a special algebraic structure for understanding logical circuit problems.

UNIT I LOGIC AND PROOFS 9

Propositional Logic – Propositional Equivalences – Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.

UNIT II COMBINATORICS 9

Mathematical Induction – Strong Induction and Well Ordering – The Basics of Counting - The

Pigeonhole Principle – Permutations and Combinations – Recurrence Relations Solving Linear Recurrence Relations Using Generating Functions – Inclusion – Exclusion – Principle and Its Applications.

UNIT III GRAPHS 9

Graphs and Graph Models – Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.

UNIT IV ALGEBRAIC STRUCTURES 9

Groups – Subgroups – Homomorphisms – Normal Subgroup and Coset – Lagrange‘s Theorem – Definitions and Examples of Rings and Fields.

UNIT V LATTICES AND BOOLEAN ALGEBRA 9

Partial Ordering – Posets – Lattices as Posets – Properties of Lattices – Lattices as Algebraic Systems – Sub Lattices – Direct Product and Homomorphism – Some Special Lattices – Boolean Algebra.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the module the student should be able to:

1. Apply Mathematical Logic to validate logical arguments and programmes.
2. Apply Combinatorial Counting principles to solve application problems.
3. Apply graph model and graph techniques for solving network other connectivity related problems.
4. Apply algebraic ideas in developing cryptograph techniques for solving network security problems.
5. Apply Boolean laws in developing and simplifying logical circuits.

REFERENCES:

1. Kenneth H.Rosen, “Discrete Mathematics and its Applications”, Tata Mc Graw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2011.
2. Tremblay J.P. and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw Hill Pub. Co. Ltd, 30th Reprint, New Delhi, 2011.
3. Ralph. P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson Education, Fifth Edition, New Delhi, 2014.
4. Thomas Koshy,” Discrete Mathematics with Applications”, Elsevier Publications, Boston, 2006.
5. Seymour Lipschutz and Mark Lipson, “Discrete Mathematics”, Schaum‘s Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.

BX5001 FUNDAMENTALS OF COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION 9

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for Logical Thinking – Problem Formulation and Development of Simple Programs - Pseudo Code - Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS 9

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and Linking Processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping Statements – Solving Simple Scientific and Statistical Problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One Dimensional and Two-Dimensional Arrays – Strings-String Operations – String Arrays - Simple Programs- Sorting- Searching – Matrix Operations.

UNIT IV POINTERS 9

Macros - Storage Classes –Basic Concepts of Pointers– Pointer Arithmetic - Example Problems - Basic File Operations

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – Definition of Function – Declaration of Function – Pass by Value – Pass by Reference – Recursion –Enumerators – Structures – Unions

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Write C program for simple applications
2. Formulate algorithm for simple problems
3. Analyze different data types and arrays
4. Perform simple search and sort.
5. Use Programming Language to solve problems.

REFERENCES:

1. Pradip Dey, Manas Ghosh, —Computer Fundamentals and Programming in C, Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, —Computer programming, Pearson Education, 2007.
3. Yashavant P. Kanetkar. —Let Us C, BPB Publications, 2011.
4. Kernighan,B.W and Ritchie,D.M, —The C Programming language, Second Edition, Pearson Education, 2006
5. Byron S Gottfried, —Programming with C, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
6. R.G. Dromey, —How to Solve it by Computer, Pearson Education, Fourth Reprint, 2007.

BX5002 DIGITAL LOGIC AND COMPUTER ORGANIZATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Boolean Logic and Functions.
- To design and realize Digital Systems with basic gates and other components using combinational and sequential circuits.
- To study the instruction sets and operations of a Processor.
- To study the different ways of communication with I/O devices and standard I/O Interfaces.
- To study the hierarchical memory system including cache memories and virtual memory.

UNIT I DIGITAL FUNDAMENTALS 9

Digital Systems – Binary Numbers – Octal – Hexadecimal Conversions – Signed Binary Numbers – Complements – Logic Gates – Boolean Algebra – K-Maps – Standard Forms – NAND – NOR Implementation.

Attested

Suggested Activities:

- Flipped classroom on value systems.

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- Proofs and simplification in class.
- Practical - Implementation of simple functions using gates.

Suggested Evaluation Methods:
- Quizzes on Number Systems and conversions.
- Mock test on Boolean simplifications.

UNIT II COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Combinational Circuits – Adder – Subtractor – ALU Design – Decoder – Encoder – Multiplexers – Introduction to Sequential Circuits – Flip-Flops – Registers – Counters.

Suggested Activities:
- Flipped classroom on analysis of combinational circuits.
- External learning - Introduction to propositional problems using conjunction, disjunction and negation.
- Practical - Implementation of simple functions using gates.

Suggested Evaluation Methods:
- Assignment on simplifying and implementing Boolean function using Multiplexer and decoders.
- Mock test for solving problems on designing counters.
- Quizzes on encoder, decoder and other topics of the unit.

UNIT III COMPUTER FUNDAMENTALS 9

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language (C language).

Suggested Activities:
- Flipped classroom on evolution and types of Computer Systems, identification of benchmarks.
- Practical - Installing and using simulator for RISC and CISC.
- Mapping and correlating a C code with its machine code.
- Practical - Opening a Computer System and studying the components.

Suggested Evaluation Methods:
- Mock Test on processor performance problems.
- Practical - Analyzing the ISA supported by the architectural simulator and running simple programs on the simulator and quizzes for evaluation.
- Quizzes on classes of Architecture.

UNIT IV PROCESSOR 9

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

Suggested Activities:
- Flipped classroom on evolution of Processor Architecture.
- Tutorial for identifying and classifying hazards in code snippet.
- Case study of the ARM and Intel processors.

Suggested Evaluation Methods:
- Quizzes on designing control unit.
- Mock test on identifying hazards in code snippet.

Attested

UNIT V MEMORY AND I/O 9

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Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA.

Suggested Activities:

- Flipped classroom on types of memory.
- Practical - Implementing a simple functional model for memory mapping in cache using C/C++.
- Discussion on hit/miss rates for various access patterns. Experimenting with different replacement policies.
- Case study of the memory hierarchy of ARM Cortex and Intel i7.

Suggested Evaluation Methods:

- Assignment on Memory Management.
- Quizzes on I/O.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Be proficient in number systems and Computer Arithmetic.
2. Design and implement digital systems with basic gates and other components using combinational and sequential circuits.
3. Familiarize and understand the organization of memory hierarchies including the basics of cache design and subsystem.
4. Understand a machine's Instruction Set Architecture (ISA) including basic instruction fetch and execute cycles, instruction formats and control flow.
5. Understand a basic input/output functioning including program controlled I/O and interrupt I/O.
6. Analyze the performance of Processors and Caches.

REFERENCES:

1. David A. Patterson, John L. Hennessy, “Computer Organization and Design, The Hardware/Software Interface”, Fifth Edition, Morgan Kaufmann/Elsevier, 2013.
2. M. Morris Mano, Michael D. Ciletti, “Digital Design”, Fifth Edition, Pearson Education, 2013.
3. Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, “Computer Organization and Embedded Systems”, Sixth Edition, Tata McGraw-Hill, 2012.
4. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Tenth Edition, Pearson Education, 2016.
5. M. Morris Mano, “Digital Logic and Computer Design”, Pearson Education, 2008.

BX5003	OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an understanding of the major Operating System components.
- To describe the services an operating system provides to users, processes and other systems.
- To describe various features of processes including scheduling, creation and termination.
- To present both software and hardware solutions of the critical section problems.
- To explain the functions of file system and performance aspects of I/O hardware and software.

UNIT I INTRODUCTION TO OPERATING SYSTEMS 9

Operating System – Role of an Operating System – Types of Operating System – Major OS Components – Operating System Operations – Operating System Services – System Calls – System Programs – Operating System Structure – Process Concept – Process Scheduling – Operations on Processes – Interprocess Communication.

Suggested Activities:

- External learning - Study of UNIX-like operating system called xv6. https://pdos.csail.mit.edu/6.828/2018/xv6/book – rev11.pdf.
- Practical - Introduction to xv6: download, build, boot (in virtual machine if needed).
- Practical - Implementation of a user program in xv6 to print “Hello Welcome to shell Programming!!”.
- External learning - Explore the xv6 processes: fork(), exit(), wait(), kill(), exec(), sleep() and wakeup().
- Flipped classroom on asynchronous overlapping processes.

Suggested Evaluation Methods:

- Discussion and questionnaire on build and boot of xv6.
- Assessing the implemented program.
- Quiz on xv6 system calls and processes.
- Discussion and quiz on asynchronous overlapping processes.

UNIT II THREADS AND CPU SCHEDULING 9

Threads – Multithreading Models – Thread Libraries – Threading Issues – Basic Concepts of Scheduling – Scheduling Criteria – Scheduling Algorithms – FCFS – SJF – Round Robin – Multiprocessor Scheduling – Real-Time CPU Scheduling.

Suggested Activities:

- Study on how the system calls can be used to create kernel threads.
- Practical - Create thread and implement multi-threading using pthread library using any language.
- Practical - Study on xv6 scheduling policies and implement xv6 priority scheduling.
- Flipped classroom on scheduling mechanisms versus policies.

Suggested Evaluation Methods:

- Quiz to judge the understanding of threads.
- Assessing the implemented program.
- Quiz to check the understanding of the scheduling concepts in xv6.
- Discussions and assignment evaluation on scheduling mechanisms.

UNIT III PROCESS SYNCHRONIZATION 9

Background – Critical Section Problem – Synchronization Hardware – Mutex Locks – Semaphores – Semaphores Usage – Semaphores Implementation – Monitors – Monitors Usage – Dining Philosophers Solutions Using Monitors – Implementation of Monitor Using Semaphores.

Suggested Activities:

- Practical - Implementation of at least one form of producer consumer problem using any Programming Language.
- Practical - Implementation a mutex locks using any Programming Language.
- Practical - Implementation of counting semaphores in xv6.

Suggested Evaluation Methods:

- Evaluation of the implemented programs.

UNIT IV MEMORY MANAGEMENT 9

Background – Swapping – Contiguous Memory Allocation – Paging – Segmentation – Virtual Memory – Demand Paging – Copy-on-Write – Page Replacement Policies: FIFO, Optimal, LRU – Allocation of Frames – Thrashing.

Suggested Activities:

- Flipped classroom on various segmentation schemes.

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- Analyze and justify why mobile Operating Systems such as android, iOS do not support swapping.
- Study on how memory management and paging works in xv6.
- Practical - Implementation of copy-on-write fork in xv6.

Suggested Evaluation Methods:

- Quiz on segmentation schemes.
- Discussions on swapping.
- Quiz on memory management and paging of xv6.
- Assessing the understanding of copy-on-write fork in xv6 through programming assessment.

UNIT V I/O SYSTEMS 9

I/O Hardware – Application I/O Interface – Kernel I/O Subsystem – Communication with I/O devices – STREAMS.

Suggested Activities:

- External learning - Study on I/O system calls (open, read, write, ioctl, close) in xv6.
- Analyzing and identifying the issues to be addressed while assigning priorities to different interrupts, handling simultaneous interrupts from different devices.

Suggested Evaluation Methods:

- Classroom quiz on I/O system calls in xv6.
- Cooperative discussion on handling interrupts.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Describe how Operating Systems have evolved over time from primitive batch systems to sophisticated multi-user systems.
2. Understand the basic concepts of Operating System process control, synchronization, and scheduling.
3. Understand the concepts and techniques involved in operating system memory management, secondary storage and file systems.
4. Explain the basic structure and functions of Operating Systems.
5. Identify the problems related to process management and synchronization and apply learned methods to solve basic problems.
6. Demonstrate knowledge in applying system software and tools available in modern Operating Systems.

REFERENCES:

1. Silberschatz, Abraham, Greg Gagne and Peter B. Galvin, “Operating System Concepts”, Ninth Edition, Wiley, 2012.
2. Russ Cox, Frans Kaashoek and Robert Morris, “xv6: A Simple, Unix – like Teaching Operating System”, Revision 11. (https://pdos.csail.mit.edu/6.828/2018/xv6/book-rev11.pdf)
3. B. Molay,“Understanding Unix/Linux Programming: A Guide to Theory and Practice”, Third Edition, Prentice Hall, 2003.
4. William Stallings, “Operating Systems: Internals and Design Principles”, Seventh Edition, Pearson Education, 2013.
5. Andrew S. Tanenbaum, “Modern Operating Systems”, Adison Wesley, 2009.
6. H. M. Deital, P. J. Deital, D. R. Choffnes, “Operating Systems”, Third Edition, Pearson Education, 2015.
7. Source Code: git clone git://pdos.csail.mit.edu/xv6/xv6.git.

BX5004	BASIC DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamental concepts of Data Structures.
- To learn the concepts of Stacks, Queues, and its applications.
- To understand about Linked Lists.
- To understand the concepts of non-linear Data Structures.
- To learn the usage of sorting techniques.

UNIT I INTRODUCTION **9**

Data Types – Abstract Data Types (ADTs) – Algorithm and Problem Solving – Data Structure: Array - Data Structure Operations - Algorithm: Complexity – Time, Space Tradeoff.

Suggested Activities:

- Flipped classroom on fundamentals of Data Structures.
- External learning – ADT's, Arrays.
- Practical - Implementation of basic operations of Data Structures with Arrays.

Suggested Evaluation Methods:

- Quizzes on basic concepts of Data Structures.
- Assignments on basic operations in Arrays.
- Demonstration for practical learning implementations.

UNIT II STACK & QUEUE **9**

Stack: Basic Operations, Implementation of Stacks – Applications: Infix to Postfix Conversion- Expression Evaluation – Queue: Basic Operations, Implementation of Queues – Applications.

Suggested Activities:

- Flipped classroom on basics of Stacks and Queues.
- External learning - Double ended queue.
- Practical - Implementation of Tower of Hanoi.
- Practical - Implementation of the Evaluation of expression using Stack.
- Practical - Implementation of any one application of Queue.

Suggested Evaluation Methods:

- Quizzes on Applications of Stack and Queue.
- Assignments on Double ended queues.
- Demonstration of the practical implementations.

UNIT III LINKED LISTS **9**

Linked List – Array - Based Implementation – Linked List Implementation – Doubly-Linked Lists – Circular Linked Lists – Applications.

Suggested Activities:

- Flipped classroom on basics of Linked Lists.
- External learning - Cursor based implementation of Linked Lists, applications of lists, double ended queue.
- Practical - Implementation of Polynomial using Lists.

Suggested Evaluation Methods:

- Quizzes on Linked Lists.
- Assignments on applications of Linked Lists.
- Demonstration of the practical implementations.

Attested

UNIT IV TREES **9**

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Trees: Preliminaries - Tree Traversals – Binary Trees – Complete Binary Tree - Expression Trees – Binary Search Trees.

Suggested Activities:

- Flipped classroom on fundamentals of non-linear Data Structures.
- External learning - Operations on binary search tree, complete binary tree.
- Practical - Implementation of operations such as counting the number of nodes in a BST, finding predecessor and successor of a given node, second largest node in a BST, finding the mirror image of a given tree etc.

Suggested Evaluation Methods:

- Quizzes on fundamentals of non-linear Data Structures.
- Assignments on complete binary tree.
- Demonstration for practical implementations.

UNIT V SORTING 9

Sorting Algorithms: Insertion Sort, Shell Sort, Quick Sort, Merge Sort.

Suggested Activities:

- Flipped classroom on different sorting techniques such as Bubble Sort, Selection Sort etc.
- External learning - Search algorithms, priority queues, external sorting, replacement selection technique.
- Assignment on choosing and applying an efficient sorting technique for a given problem.
- Assignment on comparison of different sorting techniques.
- Practical - Solving a given problem using efficient search technique.

Suggested Evaluation Methods:

- Quizzes on basics of sorting.
- Assignments on creation and manipulation of priority queues.
- Demonstration of the practical implementations.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Demonstrate basic concepts of Data Structures.
2. Implement stack and queue Data Structure for an application.
3. Implement list Data Structure for an application.
4. Design and implement tree Data Structures.
5. Apply sorting algorithms for a given problem.
6. Choose appropriate Data Structure and implement a given application.

REFERENCES:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 1997.
2. Y. Langsam, M. J. Augenstein, A. M. Tenenbaum, “Data Structures using C”, Pearson Education Asia, 2004.
3. V. Alfred, J. E. Hopcroft, J. D. Ullman, “Data Structures and Algorithms”, Pearson education Asia, 1983.

BX5005 DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the fundamentals of data models, conceptualize and depict a database system using ER diagram.
- To study the principles to be followed to create an effective relational database and write SQL queries to store/retrieve data to/from database systems.

- To know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.
- To learn about the internal storage structures using different file and indexing techniques and the basics of query processing and optimization.
- To study the basics of distributed databases, semi-structured and un-structured data models.

UNIT I RELATIONAL DATABASES 9

Purpose of Database System – Views of Data – Data Models – Database System Architecture – Introduction to Relational Databases – Relational Model – Keys – Relational Algebra – Relational Calculus – SQL Fundamentals – Advanced SQL features – Triggers – Embedded SQL.

Suggested Activities:

- Creating tables with key constraints, adding and removing constraints with referential integrity using DDL commands.
- Flipped classroom on relational algebra operations (selection, projection, joins etc.).
- Write SQL queries for demonstrating CRUD operations, aggregate functions and various join operations using DML commands.
- Create stored procedures for executing complex SQL transactions.
- Create triggers for alerting user/system while manipulating data.

Suggested Evaluation Methods:

- Tutorials on DDL, DML and DCL queries.
- Quizzes on relational algebra operations.
- Demonstration of created stored procedures and triggers.

UNIT II DATABASE DESIGN 9

Entity-Relationship Model – ER Diagrams – Functional Dependencies – Non-Loss Decomposition Functional Dependencies – First Normal Form – Second Normal Form – Third Normal Form – Dependency Preservation – Boyce/Codd Normal Form – Multi-Valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

Suggested Activities:

- Simple database application design using ER diagram.
- Practical - ER modeling using open source tools and realizing database.
- Study of various anomalies and normalizing table (1NF, 2NF, 3NF, BCNF).
- Flipped classroom on topics of database design and normalization.

Suggested Evaluation Methods:

- Tutorials on application specific ER Diagram.
- Tutorials on normalization and database design.

UNIT III TRANSACTION MANAGEMENT 9

Transaction Concepts – ACID Properties – Serializability – Transaction Isolation Levels – Concurrency Control – Need for Concurrency – Lock-Based Protocols – Deadlock Handling – Recovery System – Failure Classification – Recovery Algorithm.

Suggested Activities:

- Checking serializability among transactions.
- Flipped classroom on concurrency control protocols.
- Study of crash recovery algorithm (ARIES).

Suggested Evaluation Methods:

- Tutorials on serializability and crash recovery algorithm
- Quizzes on concurrency control protocols.

UNIT IV IMPLEMENTATION TECHNIQUES 9

Overview of Physical Storage Media – RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Catalog Information for Cost Estimation – Query Optimization.

Suggested Activities:

- Study of different RAID levels and its uses in different applications.
- Practical - Creation of B+ tree with insertion and deletion operations.
- Assignments on cost estimation of different types of queries.

Suggested Evaluation Methods:

- Report on applications of RAID levels.
- Tutorials on B+ Tree manipulation.
- Quizzes on hashing mechanisms.
- Exercise on cost estimation for various SQL queries.
- Evaluation of the practical assignments.

UNIT V ADVANCED TOPICS 9

Overview of Distributed Databases – Data Fragmentation – Replication – XML Databases – XML Schema – NOSQL Database: Characteristics – CAP Theorem – Types of NoSQL Datastores: Column Oriented, Document, Key-Value and Graph Types – Applications – Current Trends.

Suggested Activities:

- Design of distributed database using fragmentation.
- Creation of XML document based on XML schema.
- Creation of document and column-oriented databases and simple manipulation.

Suggested Evaluation Methods:

- Tutorials on fragmenting database tables and writing simple SQL queries.
- Assignments on creation of XML schema and validating XML documents.
- Demonstration of created document and column-oriented databases.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Model an application's data requirements using conceptual modeling and design database schemas based on the conceptual model.
2. Formulate solutions to a broad range of query problems using relational algebra/SQL.
3. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
4. Run transactions and estimate the procedures for controlling the consequences of concurrent data access.
5. Explain basic database storage structures, access techniques and query processing.
6. Describe distributed, semi-structured and unstructured database systems.

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2014.
2. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017.
3. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
4. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2010.
5. G. K. Gupta, "Database Management Systems", Tata McGraw Hill, 2011.
6. Carlos Coronel, Steven Morris, Peter Rob, "Database Systems: Design, Implementation and Management", Ninth Edition, Cengage Learning, 2011.

BX5006	SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of software processes, process models and fundamental process activities.
- To understand the fundamental concepts of requirements engineering & requirements specification and documents.
- To know about the idea of design patterns and how these are away of reusing design knowledge and experience.
- To be aware of testing processes, techniques and debugging to solve program defects.
- To learn how to use software metrics, manage risk, apply basic software quality assurance practices to ensure that software designs, development, and maintenance meet or exceed applicable standards.

UNIT I PROCESS 9

Product and Process – Evolution Process and Activities – Software Development Lifecycle Models: Waterfall Model – Incremental Models – Evolutionary Models – Spiral Model – Unified model – Prototype Model – Agile Methods.

Suggested Activities:

- In-class activity - Application specific product and process view.

Suggested Evaluation Methods:

- Quizzes on different types of models.
- Assignments on selection of suitable Software process models for a given Software specification.
- Tutorials on identification of sample application for each process model and justification of the same stating reasons.

UNIT II SOFTWARE REQUIREMENTS 9

Functional and Non-Functional Requirements – Software Requirements Document – Requirements Specification – Requirements Engineering Processes – Requirements Elicitation & Analysis – Requirements Validation – Requirements Management.

Suggested Activities:

- In class activity on software projects like an embedded computer system operating in real time. The following tasks may be performed:
  - Take a real time project and elicit requirements and form a Software Requirements Specification document.
  - Draw a process model that depicts how requirements review might be organized.

Suggested Evaluation Methods:

- Tutorial on various requirements elicitation mechanisms and selection of an appropriate strategy.
- Assignment on requirements categorization (considering contradicting, omission, commission of requirements) in a Software project.

UNIT III ANALYSIS AND DESIGN 9

Analysis Modeling Approaches: Scenario Based Modeling – UML Models – Data Modeling Concepts: Class Based Modeling, Flow Oriented Modeling – Design Process and Concepts – Design Model – Architectural Design – Pattern Based Design – Web App Design – Real Time Software Design – System Design – Data flow Oriented Design – Designing for Reuse – User Interface Design: Interface Analysis, Interface Design – Component Level Design: Designing Class Based Components, Traditional Components.

Suggested Activities:

- External learning - Use Open Source Tools to perform modeling approaches.
- In-class activity – Draw UML models for any given real time application.

Suggested Evaluation Methods:

- Assignment on determine the flow of data/events among the processes in the application under consideration.
- Assignment on designing UI of Sample application

UNIT IV SOFTWARE TESTING 9

Software Testing Strategies – White Box Testing – Black Box Testing – Basis Path Testing – Control Structure Testing – Regression Testing – Unit testing – Integration Testing – Validation Testing – System Testing – Art of Debugging.

Suggested Activities:

- External learning - Use open source testing tools to test the program defects and debug it.
- In-class activity on developing test cases for Equivalence class partitioning.
- In-class activity on developing test cases for Boundary Value Analysis.
- In-class activity on developing test cases for Basis Path testing.
- In-class activity on developing test cases for Control, Structure testing.

Suggested Evaluation Methods:

- Assignment on testing of sample application.
- Assignment on testing sample application using Black box and White box approaches and understand the differences in selecting of test cases from the test suite.
- Case studies based on any Real Time application projects.

UNIT V MANAGEMENT AND METRICS 9

Software Configuration Management – Project Management Concepts – Process and Project Metrics – Software Cost Estimation – Project Scheduling – Risk Management – Software Quality Assurance – Maintenance and Re-engineering – CASE Tools.

Suggested Activities:

- External learning - Tools for estimating software cost.
- External learning - Software Quality Models.
- In-class activity on FP metrics & Variants.

Suggested Evaluation Methods:

- Tutorial on Identification of Potential Risks for Software Project during development/ maintenance and tabulate.
- Assignment on preparation of Software Configuration Management template for a software project.
- Calculation of Test metrics for Sample application.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand of the role and impact of Software Engineering in contemporary business, global, economic, environmental, and societal context.
2. Elicit the requirements for real, time problems. Analyze and use Open Source Tools for project designing.
3. Develop User Interface design for the given system.
4. Analyze and resolve Information Technology problems through the application of systematic approaches and diagnostic tools.
5. Estimate the cost of software and apply software management principles.

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6. Understand the issue of Software Quality and activities present in typical Quality Management Process.

REFERENCES:

1. Roger S. Pressman, “Software Engineering: A Practitioner‘s Approach”, Seventh Edition, McGraw Hill International edition, 2009.
2. Ian Sommerville, “Software Engineering, Ninth Edition”, Pearson Education, 2008.
3. Watts S.Humphrey, “A Discipline for Software Engineering”, Pearson Education, 2007.

BX5007	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the object-oriented concepts of Java.
- To learn GUI based application development using Java
- To learn the Threading concepts and generic collections used in Java.
- To learn network programming in Java.
- To design and develop small applications using core Java.

UNIT I JAVA BASICS 9

Overview of Java – Java Fundamentals: Classes, Objects, Methods and Strings – Control Statements – Arrays and Array Lists.

Suggested Activities:

- Flipped classrooms on basics of Java.
- Learning and Implementation in the following topics.
    - Creation and manipulation of java programs using classes and objects.
    - Creation of simple exercises using Arrays and Array Lists.

Suggested Evaluation Methods:

- Quiz on Java Fundamentals.
- Demonstration of Java Programs using Classes and Objects.

UNIT II CLASSES AND OBJECTS 9

Classes and Objects – Object Oriented Programming: Inheritance – Polymorphism – Interfaces – Packages – Exception Handling – Fundamentals of Characters and Strings- String- StringBuilder and Character classes- Regular Expressions and Patterns.

Suggested Activities:

- Flipped classrooms on Exception Handling.
- Learning and Implementation in the following topics.
    - Creation and Manipulation of Java Programs using String Objects of Class String, String Builder and Characters.
    - Creation of Java applications using Interfaces, Packages and User Defined Exceptions.

Suggested Evaluation Methods:

- Quiz on Exception Handling.
- Demonstration of Java programs using Interfaces and Packages.

UNIT III AWT AND THREADS 9

Applets – Applet based GUI – GUI Components- Event Handling – Basics of Swings – Threads – Multithreading- Thread Synchronization.

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Suggested Activities:

- Flipped classrooms on Graphics Object and 2D API’s.

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- Learning and implementation in the following topics.
    - Creation of Java programs using Multithreading.
    - Creation of Java Applications using Applets and Swing.

Suggested Evaluation Methods:

- Quiz on Java Graphical objects.
- Demonstration and Evaluation of Java programs using AWT and Event Handling.

UNIT IV IO AND GENERIC CLASSES 9

Files and Streams - Object Serialization – Recursion Concepts - Generic Collections Overview – Collection Methods- Generic Classes-Implementation of Generic Methods– Overloading Generic Methods -

Suggested Activities:

- Flipped classroom on Generic Collections
- Learning and implementation in the following topics.
    - Creation of Java Applications using Generics.
    - Creation of Java Applications using Files, Streams and Serialization.

Suggested Evaluation Methods:

- Quiz on Java Generic Collections and Classes.
- Demonstration and Evaluation of Java applications using File, Streams and Generics.

UNIT V JAVA NETWORKING 9

Networking Overview - Manipulating URLs – Reading web pages – Client/Server Interaction using Stream Sockets Connections – Connectionless Client/Server Interaction– Multicasting – Case Study.

Suggested Activities:

- Flipped classroom on basic networking and URL classes.
- Implementation of Java programs using URL classes to read a live web page.
- Creation of Chat applications using TCP and UDP protocols.
- Creation of Group Chat application.

Suggested Evaluation Methods:

- Quiz on Java Networking and URL classes.
- Demonstration and Evaluation of Java applications using URL classes, sockets, datagrams and multicasting.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Implement object-oriented concepts of Java programming.
2. Work with Interfaces, Packages and String Building concepts of Java.
3. Design and implement java applications with graphical user interfaces.
4. Design and implement java applications with appropriate input/output streams.
5. Work with Networking concepts in Java.
6. Design and develop real time applications using core Java.

REFERENCES:

1. Paul J. Deitel, Harvey Deitel, “Java How to Program”, Eleventh Edition, Pearson, 2017.
2. Cay S.Horstmann, “Core Java Volume I & II”, Pearson Education, 2018.
3. Herbert Schildt, “Java the Complete Reference”, Eighth Edition, Tata McGraw Hill, 2011.

BX5008 C PROGRAMMING AND DATA STRUCTURES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To introduce the concepts of structured programming language.
- To learn and implement linear data structures.
- To study and implement nonlinear data structures.
- To develop skills in design and implementation of data structures and their applications.
- To study and analyze the different sorting techniques.

EXPERIMENTS:

1. Implementation of simple programs in C using Data types, Variables, Conditional and Iterative statements.
2. Implementation of simple programs in C using arrays.
3. Implementation of simple programs in C using functions.
4. Implementation of simple programs in C using structures and unions.
5. Implementation of simple programs in C using pointers.
6. Implementation of stack using arrays and applications of stack.
7. Implementation of queue using arrays.
8. Implementation of singly linked list.
9. Implementation of doubly linked list.
10. Implementation of circular linked list and applications of lists.
11. Implementation of binary search tree.
12. Implementation of sorting algorithms – insertion sort, shell sort, merge sort.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Implement C programming concepts.
2. Develop simple C programs to solve an application.
3. Choose and apply linear data structure for a given application.
4. Choose and apply non-linear data structures for a given application.
5. Use sorting techniques for a given real world application.
6. Apply knowledge to solve computer science and information technology problems using the basics of C programming and the concepts of data structures.

BX5009 DATABASE MANAGEMENT SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

OBJETIVES:

- To learn and implement important commands in SQL.
- To learn the usage of nested and joint queries.
- To understand functions, procedures, and procedural extensions of databases.
- To understand design and implementation of typical database applications.
- To be familiar with the use of a front-end tool for GUI based application development.

LABORATORY EXERCISES:

- Create a database table, add constraints (primary key, unique, check, not null), insert rows, update, and delete rows using SQL DDL and DML commands.
- Create set of tables, add foreign key constraints, and incorporate referential integrity.
- Query the database tables using different ‘where’ clause conditions and implement aggregate functions.
- Query the database tables and explore sub queries and simple join operations.
- Query the database tables and explore natural, equi and outer joins.
- Write user defined functions and stored procedures in SQL.
- Execute complex transactions and realize DCL and TCL commands.
- Write SQL Triggers for insert, delete, and update operations in database table.

- Create a View and index for database tables with large number of records.
- Create an XML database and validate it using XML schema.
- Create Document, column and graph-based data using NOSQL database tools.
- Develop a simple GUI based database application and incorporate all the above-mentioned features.

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Create databases with different types of key constraints.
2. Write simple and complex SQL queries using DML and DCL commands.
3. Realize database design using 3NF and BCNF.
4. Use advanced features such as stored procedures and triggers and incorporate in GUI based application development.
5. Create XML database and validate with meta-data (XML schema).
6. Create and manipulate data using NOSQL database.

BX5010 JAVA PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- Understand Object Oriented features of Java.
- Learn about the GUI creation and Event Handling in java.
- Understand the File concepts and generic collections of Java.
- Learn about Socket programming and networking in Java.

EXPERIMENTS:

1. Write a Java program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num 2 is displayed in the result field when the divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception. Display the exception in a message dialog box.
2. Write a Java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
3. Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with “Stop” or “Ready” or “Go” should appear above the buttons in selected color. Initially, there is no message shown.
4. Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired (Use Adapter classes).
5. Write a Java program for the following: Create a doubly linked list of elements. Delete a given element from the above list. Display the contents of the list after deletion.
6. Write a java program that implements Array Index out of bound Exception using built-in-Exception.
7. Write a Java program that implements bank transactions using user denied exception.
8. Write a Java program to identify the significance of finally block in handling exceptions.
9. Write a Java program to generate multiple threads of creating clock pulses. (using runnable interface)
10. Write a Java program to implement mouse events like mouse pressed, mouse released, and mouse moved by means of adapter classes.
11. Write a Java program to demonstrate Window events on frame
12. Write a Java program to design the page authenticating username and password by using SWING.

13. Write a Java program to design a calculator by using Grid Layout.
14. Write a Java program that implements a simple client server application. The client sends data to server. The server receives the data uses it to produce a result and then sends the result back to the client then the client displays the result on the console.
15. Write a Java program that loads names and phone numbers from a text file where the data is organized as one line per record and each field in a record are separated by a tab (\t). It takes a name or phone number as input and prints the corresponding other value from the hash table (hint: use hash tables).

TOTAL: 60 PERIODS

OUTCOMES:

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

1. Understand the structure and model of the Java programming language
2. Implement programs using the Object-Oriented features of Java
3. Use the Java programming language for various programming technologies
4. Develop software in the Java programming language,
5. Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements
6. Propose the use of certain technologies by implementing them in the Java programming language to solve the given problem

Attested

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