NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabus

for

Master of Computer Applications [R22]

[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the Academic year 2022-23 onwards)

April 2025

INSTITUTE VISION AND MISSION	
VISION	• To be an Institute of excellence providing quality Engineering, Technology and Management education to meet the ever changing needs of the society.
MISSION	• To provide quality education to produce ethical and competent professionals with social responsibility • To excel in the thrust areas of Engineering, Technology and Entrepreneurship by solving real- world problems. • To create a learner centric environment and improve continually to meet the changing global needs.

MASTER OF COMPUTER APPLICATIONS	
VISION	• To be a centre of excellence providing quality education in the field of Computer Applications to meet the changing needs of the society.
MISSION	• To provide quality education to produce ethical and competent master level Computer Application professionals with social responsibility • To excel in the thrust areas of Computing and Applications by solving real-world challenges. • To provide a learner centric environment and improve continually to meet the changing global computing application needs.
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	Post Graduates of Computer Applications will be able to **PEO1: Core Competency:** Apply computing skills to plan, analyze, design, develop and implement the software products for real time systems and excel as software professionals. **PEO2: Research, Innovation and Entrepreneurship:** Apply recent tools, technologies and innovative ideas in solving real world problems. **PEO3: Ethics, Human values and Life-long learning:** Exhibit professional ethics in the industry and possess the necessary skills for working in multi-disciplinary areas with a strong focus on life-long learning.
PROGRAMME SPECIFIC OUTCOMES (PSO)	Post Graduates of Computer Applications will be able to • Select appropriate data models, architecture and platform to develop software applications for real time environments. • Develop practical competency in programming languages, open source platforms and to provide a foundation for research and entrepreneurship.

PROGRAM OUTCOMES:

At the end of a programme a student will be able to demonstrate ability to

a-l	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
A	Multidisciplinary Knowledge	PO1	Understand and Apply mathematical foundation, computing and domain knowledge for the conceptualization of computing model of problems.
B	Investigative and Analytical Skills	PO2	Identify, Analyze the computing requirements of a problem and solve those using computing principles.
C	Design and Development of Solutions	PO3	Design and Evaluate a computer based system, components and process to meet the specific needs of applications.
D	Lifelong Learning	PO4	Recognize the need for and develop the ability to engage in continuous learning as a Computing professional.
E	Managerial and Leadership Skill	PO5	Apply understanding of management principles with computing knowledge to manage projects in multidisciplinary environments.
F	Communication	PO6	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
G	Ethical, Environmental Concern and Social Responsible, Sustainability	PO7	Understand economical, environmental, social, health, legal, ethical issues within local and global contexts and consequential responsibilities relevant to professional practice.
H	Individual and Team Work	PO8	Function effectively in a team environment to accomplish a common goal.
I	Project Management and Finance	PO9	Identify opportunities and use innovative ideas to create value and wealth for the betterment of the individual and society.
J	Research and Consultancy	PO10	Use knowledge to analyze, interpret the data and synthesis the information to derive valid conclusions using research methods.
K	Modern Tool Usage	PO11	Ability to use the techniques, skills, and be familiar with modern software tools necessary for Computer Application practice.
L	Proficiency	PO12	Expertise in developing application with required domain knowledge.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3	3	3	2	1	2	2	2	2	3	3
2	3	3	3	3	2	2	2	1	2	3	2	2
3	3	3	3	3	2	2	3	1	2	3	2	2

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3	3	3	2	1	2	2	2	2	3	3
2	3	3	3	3	2	1	2	2	2	2	3	3

Contribution 1: Reasonable 2: Significant 3: Strong

SEMESTER: I									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1	22CAB01	Advanced Data Structures and Algorithms	PC	NIL	3	3	0	0	3
2	22CAB02	Operating Systems	PC	NIL	3	3	0	0	3
3	22CAB03	Computer Networks	PC	NIL	3	3	0	0	3
4	22CAB04	Cloud Computing	PC	NIL	3	3	0	0	3
5	22CAB05	Python Programming	PC	NIL	3	3	0	0	3
6	22CAB06	Database Management Systems	PC	NIL	3	3	0	0	3
PRACTICAL									
7	22CAP01	Advanced Data Structures and Algorithms Laboratory	PC	NIL	4	0	0	4	2
8	22CAP02	Database Management Systems Laboratory	PC	NIL	4	0	0	4	2
9	22CAE01	English for Pragmatic Usage	EEC	NIL	2	0	0	2	1
				TOTAL	**28**	**18**	**0**	**10**	**23**

SEMESTER: II									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1	22CAA01	Probability and Statistics for Computer Science	FC	NIL	3	3	0	0	3
2	22CAB07	Data Mining and Data Warehousing	PC	22CAB06	3	3	0	0	3
3	22CAB08	Programming in Java	PC	NIL	3	3	0	0	3

4	22CAB09	Big Data Analytics	PC	NIL	3	3	0	0	3
5	E1	Elective – I	PE	Ref. PE	3	3	0	0	3
6	E2	Elective – II	PE/OE	Ref. PE/OE	3	3	0	0	3
PRACTICAL									
7	22CAP03	Programming in Java Laboratory	PC	NIL	4	0	0	4	2
8	22CAP04	Big Data Analytics Laboratory	PC	NIL	4	0	0	4	2
				TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER: III									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1	22CAB10	Machine Learning	PC	NIL	3	3	0	0	3
2	22CAB11	Web Technology	PC	NIL	3	3	0	0	3
3	22CAB12	Cyber Security	PC	22CAB03	3	3	0	0	3
4	E3	Elective – III	PE	Ref. PE	3	3	0	0	3
5	E4	Elective – IV	PE	Ref. PE	3	3	0	0	3
6	E5	Elective – V	PE	Ref. PE	3	3	0	0	3
PRACTICAL									
7	22CAP05	Machine Learning Laboratory	PC	NIL	4	0	0	4	2
8	22CAP06	Web Technology Laboratory	PC	NIL	4	0	0	4	2
9	22CAE02	Mini Project	EEC	NIL	4	0	0	4	2
				TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER: IV									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
PRACTICAL									
1	22CAE03	Project Work	EEC	22CAE02	24	0	0	24	12
				TOTAL	**24**	**0**	**0**	**24**	**12**

(A) FC, PC, PE, OE, and EEC Courses

(a) Foundation Courses (FC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CAA01	Probability and Statistics for Computer Science	**FC**	NIL	3	3	0	0	3

(b) Professional Core (PC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CAB01	Advanced Data Structures and Algorithms	**PC**	NIL	3	3	0	0	3
2	22CAB02	Operating Systems	**PC**	NIL	3	3	0	0	3
3	22CAB03	Computer Networks	**PC**	NIL	3	3	0	0	3
4	22CAB04	Cloud Computing	**PC**	NIL	3	3	0	0	3
5	22CAB05	Python Programming	**PC**	NIL	3	3	0	0	3
6	22CAB06	Database Management Systems	**PC**	NIL	3	3	0	0	3
7	22CAB07	Data Mining and Data Warehousing	**PC**	22CAB06	3	3	0	0	3
8	22CAB08	Programming in Java	**PC**	NIL	3	3	0	0	3
9	22CAB09	Big Data Analytics	**PC**	NIL	3	3	0	0	3
10	22CAB10	Machine Learning	**PC**	NIL	3	3	0	0	3
11	22CAB11	Web Technology	**PC**	NIL	3	3	0	0	3
12	22CAB12	Cyber Security	**PC**	22CAB03	3	3	0	0	3
13	22CAP01	Advanced Data Structures and Algorithms Laboratory	**PC**	NIL	4	0	0	4	2
14	22CAP02	Database Management Systems Laboratory	**PC**	NIL	4	0	0	4	2
15	22CAP03	Programming in Java Laboratory	**PC**	NIL	4	0	0	4	2

16	22CAP04	Big Data Analytics Laboratory	**PC**	NIL	4	0	0	4	2
17	22CAP05	Machine Learning Laboratory	**PC**	NIL	4	0	0	4	2
18	22CAP06	Web Technology Laboratory	**PC**	NIL	4	0	0	4	2

(c) Professional Electives

Artificial Intelligence and Data Science

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CAX01	Internet of Things	**PE**	NIL	3	3	0	0	3
2	22CAX02	Artificial Intelligence	**PE**	NIL	3	3	0	0	3
3	22CAX03	Robotic Process Automation	**PE**	NIL	3	3	0	0	3
4	22CAX04	Natural Language Processing	**PE**	NIL	3	3	0	0	3
5	22CAX05	Data Center Virtualization	**PE**	NIL	3	3	0	0	3
6	22CAX06	Social Network Analysis	**PE**	NIL	3	3	0	0	3
7	22CAX21	Deep Learning and its Applications	**PE**	NIL	3	3	0	0	3
Software Engineering and Entrepreneurship									
8	22CAX07	Microservices and Devops	**PE**	NIL	3	3	0	0	3
9	22CAX08	Agile Methodology	**PE**	NIL	3	3	0	0	3
1	22CAX09	Organizational Behaviour	**PE**	NIL	3	3	0	0	3
11	22CAX10	User Interface Design	**PE**	NIL	3	3	0	0	3
12	22CAX11	Design Thinking	**PE**	NIL	3	3	0	0	3
13	22CAX12	Entrepreneurship	**PE**	NIL	3	3	0	0	3
14	22CAX13	Intellectual Property Rights	**PE**	NIL	3	3	0	0	3
15	22CAX14	Human Resource Management	**PE**	NIL	3	3	0	0	3
16	22CAX22	Full Stack Framework	**PE**	NIL	3	3	0	0	3
17	22CAX23	Digital Marketing	**PE**	NIL	3	3	0	0	3

Digital Security									
17	22CAX15	Ethical Hacking	**PE**	NIL	3	3	0	0	3
18	22CAX16	Digital Forensics	**PE**	22CAB12	3	3	0	0	3
19	22CAX17	Virtualization and Cloud Security	**PE**	22CAB04	3	3	0	0	3
20	22CAX18	Blockchain Technology	**PE**	NIL	3	3	0	0	3
21	22CAX19	Software Quality Assurance	**PE**	NIL	3	3	0	0	3
22	22CAX20	Information Security	**PE**	NIL	3	3	0	0	3

(d) Open Elective Courses (OE)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CAO01	Employability Enhancement and Analytical Skills	**OE**	NIL	3	3	0	0	3

(e) Employability Enhancement Courses (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CAE01	English for Pragmatic Usage	**EEC**	NIL	2	0	0	2	1
2	22CAE02	Mini Project	**EEC**	NIL	4	0	0	4	2
3	22CAE03	Project Work	**EEC**	22CAE02	24	0	0	24	12

Bridge Courses

For the MCA Students admitted under Non-Computer Science background category

Bridge Courses (BC)									
S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
Semester – I									
1	22CAW01	Fundamentals of Computers	**BC**	NIL	3	3	0	0	3
2	22CAW02	Mathematical Foundation of Computer Science	**BC**	NIL	3	3	0	0	3
Semester – II									
3	22CAW03	Object Oriented Programming using C++	**BC**	NIL	3	3	0	0	3
4	22CAW04	Computer Organization	**BC**	NIL	3	3	0	0	3

Total =12 Credits

SUMMARY						
SL. No.	**SUBJECT AREA**	**CREDITS AS PER SEMESTER**				**CREDITS TOTAL**
		I	**II**	**III**	**IV**	
1	**FC**	0	3	0	0	**03**
2	**PC**	22	13	13	0	**48**
3	**PE/OE**	0	6	9	0	**15**
4	**EEC**	1	0	2	12	**15**
TOTAL CREDITS		**23**	**22**	**24**	**12**	**81**

Total =81 Credits

22CAB01 ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

Course Objectives:

- To develop operations on Linear and Non Linear Data Structures using appropriate Data Structures

	Course Outcomes: The Student will be able to	**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply operations on Linear Data Structures	Ap	20%
CO2	Analyze and develop operations on Linear Data Structures	An	20%
CO3	Design solutions for applications using appropriate data structures	Ap	40%
CO4	Carry out independent investigations of operations on various data structures	An	20%
CO5	Discuss Algorithms for various applications using Data Structures	U	Internal Assessment

UNIT I - LINEAR DATA STRUCTURES **(9)**

Introduction - Abstract Data Types (ADT) – Stack – Queue – Circular Queue - Double Ended Queue - Applications of Stack: Evaluating Arithmetic Expressions - Applications of Queue - Linked Lists - Singly Linked List - Doubly Linked lists – Applications of Linked List: Polynomial Manipulation.

UNIT II - NON-LINEAR TREE STRUCTURES **(9)**

Tree : Basic Terminologies, implementation of tree- Binary Tree – Types of Binary tree- Properties of Binary tree - Expression trees – Binary tree traversals – Applications of trees – Binary search tree - Balanced Trees - AVL Tree - B-Tree - Red black Tree.

UNIT III – GRAPHS **(9)**

Representation of graph - Graph Traversals - Depth-first and breadth-first traversal - Applications of graphs - Topological sort – Shortest-path algorithms – Dijkstra's algorithm – Bellman-Ford algorithm – Floyd's Algorithm - Minimum spanning tree – Prim's and Kruskal's algorithms.

UNIT IV - ALGORITHM DESIGN AND ANALYSIS **(9)**

Algorithm Analysis – Asymptotic Notations - Divide and Conquer – Merge Sort – Quick Sort - Binary Search - Greedy Algorithms – Knapsack Problem – Dynamic Programming: Characteristics, Components, and Comparison - Applications.

UNIT V - ADVANCED ALGORITHM DESIGN AND ANALYSIS **(9)**

Backtracking – N-Queen's Problem – Sum of Subset Problems –Graph Coloring Problem - Branch and Bound: Introduction, Travelling Salesman Problem, 0/1 Knapsack Problem - P & NP Problems – NP-Complete Problems – Approximation Algorithms for NP-Hard Problems.

TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Anany Levitin "Introduction to the Design and Analysis of Algorithms", Pearson Education, 2017.
2. M. A. Weiss, "Data Structures and Algorithm Analysis in Java", Pearson Education Asia, 2013.
3. Rajesh K Shukla, "Analysis and Design of Algorithms: A Beginner's Approach", Wiley Publication, 2015.
4. Gilles Brassard, "Fundamentals of Algorithms", Pearson Education, 2015.
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press, 2015.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2	2	3												
3			3									2	2	
4		3	3										2	
5			3									2	2	
CO	2	3	3									2	2	

22CAB02 OPERATING SYSTEMS				
	L	T	P	C
	3	0	0	3
PRE REQUISITE : NIL				
Course Objective:	• To describe operating system basics & features, Process management, Memory management and Device management and study various Operating Systems			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Be competent in recognizing operating systems features and issues.	Ap	20%
CO2	Analyze about Process, semaphores and deadlocks.	An	20%
CO3	Apply concept about Paging and Segmentation.	Ap	40%
CO4	Analyze the file system and I/O device management.	An	20%
CO5	Examine about design, memory and I/O management in various Operating Systems	U	Internal Assessment

UNIT I – INTRODUCTION	**(9)**
Introduction – Role of OS, Types of OS - Operating Systems operations - Operating Systems and services – Processes – CPU Scheduling approaches.	
UNIT II - PROCESS MANAGEMENT	**(9)**
Process Synchronization – Semaphores – Deadlocks – Handling Deadlocks – Threads – Multithreading.	
UNIT III - MEMORY MANAGEMENT	**(9)**
Memory Management – Paging – Segmentation – Virtual Memory – Demand Paging – Replacement Algorithms.	
UNIT IV - STORAGE MANAGEMENT	**(9)**
Disk Scheduling Approaches – File Systems – Design Issues – User interfaces to File Systems – I/O Device Management.	
UNIT V - CASE STUDIES	**(9)**
Case Study –Design and Implementation of the UNIX OS, Process Model and Structure – Memory Management - File System – UNIX I/O Management and Device Drivers – Windows – System Components – Process Management.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Abraham Silberschatz Peter B. Galvin, G. Gagne, "Operating System Concepts", Tenth Edition, John Wiley and Sons Inc., USA, 2018.
2. Willam Stalling, "Operating System", Seventh Edition, Pearson Education, 2012.
3. M. J. Bach, "Design of the Unix Operating System", Fifth Edition, Pearson Education, 1990.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3												
2		3								2			2	2
3	3		2										2	
4		3	2											
5				2								2	2	2
CO	3	3	2	2								2	2	2

22CAB03 COMPUTER NETWORKS				
	L	T	P	C
	3	0	0	3
PRE REQUISITE : NIL				
Course Objective:	• To provide a comprehensive understanding of computer networks layers and solid foundation in data communications, network architecture, and protocols, with an emphasis on how different layers of the network interact to enable effective communication.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the Physical Layer's components, including transmission media, line coding schemes, and transmission modes, and evaluate their impact on network performance.	An	20%
CO2	Demonstrate understanding of link-layer addressing and implement error detection and correction techniques, including block coding and cyclic codes.	Ap	20%
CO3	Implement and evaluate routing algorithms, including Distance Vector Routing, Link State Routing, and BGP4, and assess their impact on network performance.	Ap	20%
CO4	Analyze and implement congestion control and avoidance techniques to optimize network traffic.	An	20%
CO5	Demonstrate the ability to configure and troubleshoot network applications and understand their role in supporting network communication.	An	20%

UNIT I - NETWORK INTRODUCTION & PHYSICAL LAYER	**(9)**
Data Communications – Networks – Network Types – Standards and Administration - Protocol Layering - TCP/IP Protocol Suite – OSI Model – Physical Layer: Transmission Media – Line Coding and its Schemes - Transmission Modes.	
UNIT II - DATA LINK LAYER	**(9)**
Introduction of DLL – Link-Layer Addressing - Error Detection and Correction: Types of Errors, Block Coding - Cyclic Codes – Checksum - Forward Error Correction: Hamming Distance – Data Link Control: DLC Services – Data-Link Layer Protocols - HDLC. Wired LANs: Standard Ethernet - Fast Ethernet - Gigabit Ethernet - Wireless LAN: IEEE 802.11 Project.	
UNIT III - NETWORK LAYER	**(9)**
Switching – Circuit Switched Networks - Packet Switching – Structure of a Switch – Network Layer Services and Performance – IPV4 Addresses – Routing Algorithms: Distance Vector Routing – Link State Routing – BGP4.	
UNIT IV - TRANSPORT LAYER	**(9)**
Transport Layer Services – Connection Establishment – Transport Layer Protocols – User Datagram Protocol (UDP) - Transmission Control Protocol (TCP) – Congestion Control and Avoidance.	
UNIT V - APPLICATION LAYER	**(9)**
World Wide Web and HTTP – FTP – Electronic Mail – TELNET – Secure Shell (SSH) - Domain Name Space (DNS).	
	TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Behrouz A. Forouzan, "Data Communication and Networking", Fifth Edition, Tata McGraw-Hill, 2013.
2. Andrew S. Tanenbaum, Nick Feamster, David J. Wetherall, "Computer Networks", Sixth Edition, 2022.
3. William Stallings, "Data and Computer Communications", Tenth Edition, Pearson Education, 2017.
4. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson, 2016.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3												
2	3												3	
3		3								3			3	
4										3			3	
5		3												
CO	3	3								3			3	

22CAB04 CLOUD COMPUTING				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL				
Course Objective:	• To provide a comprehensive understanding of cloud computing fundamentals, architecture, and services, including development, deployment, and management. • To equip students with practical skills in designing, implementing, and evaluating cloud-based solutions, including storage, sharing, and collaboration tools.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Explore the complex cloud computing concepts.	An	20%
CO2	Apply their knowledge of cloud computing concepts to real-world scenarios and problems.	Ap	40%
CO3	Analyze and evaluate cloud computing solutions, services, and tools.	An	20%
CO4	Demonstrate hands-on application of cloud computing skills and knowledge.	Ap	20%
CO5	Generate and evaluate new ideas for cloud storage and sharing solutions.	C	Internal Assessment

UNIT I - CLOUD COMPUTING FUNDAMENTALS	**(9)**
Define Cloud Computing – Cloud Types – Examining the Characteristics – Benefits, Disadvantages – Cloud Computing Architecture – Exploring the Cloud Computing Stack – Connecting to the Cloud.	
UNIT II - DEVELOPING CLOUD SERVICES	**(9)**
Web–Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On Demand Computing – Discovering Cloud Services - Development Services and Tools – Amazon Ec2 – Google App Engine – IBM Clouds.	
UNIT III - USING CLOUD SERVICES	**(9)**
Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management – Collaborating on Word Processing – Collaborating on Databases – String and Sharing Files.	
UNIT IV - OUTSIDE THE CLOUD	**(9)**
Evaluating Web Mail Services – Evaluating Instant Messaging – Evaluating Web Conference Tools – Creating Groups on Social Networks – Evaluating on Line Groupware – Collaborating via Blogs and Wikis.	

UNIT V - STORING AND SHARING	(9)
Understanding Cloud Storage – Evaluating on Line File Storage – Exploring on Line Book Marking Services – Exploring on Line Photo Applications – Exploring Photo Sharing Communities – Controlling it with Web Based Desktops. Introduction to Cloud Databases – Hadoop - Case Study.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Barrie Sosinsky, "Cloud Computing", First Edition, Wiley Publishing inc, Canada 2018.
2. Kai Hwang, Geoffrey C Fox, Jack G.Dongarra, "Distributed and Cloud Computing, from Parallel Processing to the Internet of Things", Morgan Kautomann Publishers, 2012.
3. Michael Miller, "Cloud Computing", Pearson Education, New Delhi, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3				3								3	
2		3												
3		3							3	3		3	3	3
4					3								3	3
5			3								3		3	
CO	3	3	3		3				3	3	3	3	3	3

22CAB05 PYTHON PROGRAMMING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To develop the logical thinking abilities and to propose novel solutions for real world problems through programming language constructs. • To deepen the empirical knowledge in solving real time problems.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of Python programming to develop different applications	Ap	20%
CO2	Apply control statements and operators to solve basic programming problems.	Ap	20%
CO3	Enhance problem-solving skills by applying Python to a variety of challenges and scenarios across different disciplines.	Ap	20%
CO4	Develop modular code using functions and manage file operations efficiently.	C	20%
CO5	Develop a project using python's built in modules and frameworks.	C	20%

UNIT I - INTRODUCTION DATA, EXPRESSIONS, STATEMENTS	**(9)**
Introduction to Python and installation, variables, expressions, statements, Numeric data types: int, float, Boolean, string. Basic data types: List - List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters. Tuple - Create and Access, Operations, Functions, Inserting, Deleting and Modifying elements in Tuple. Sets: Operations and Methods. Dictionaries: Operations and Methods.	
UNIT II - CONTROL FLOW, LOOPS, FUNCTIONS	**(9)**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if- elif-else); Iteration: statements break, continue. Functions - function and its use, pass keyword, flow of execution, parameters and arguments.	
UNIT III - ADVANCED FUNCTIONS, ARRAYS	**(9)**
Fruitful functions: return values, parameters, local and global scope, function composition, Recursion; Advanced Functions: lambda, map, filter, reduce, basic data type comprehensions. Python arrays: create an array, Access the Elements of an Array, array methods.	
UNIT IV - FILES, EXCEPTIONS	**(9)**
Files: Types of file, file I/O, Seek() and tell() methods, Zipping and Unzipping files Exception: Errors in python programs, Exceptions, Exception Handling, Types of Exceptions, Introduction to basic standard libraries.	
UNIT V - OBJECT ORIENTED PROGRAMMING, FRAMEWORK	**(9)**
Object, Class, Method, Inheritance, Polymorphism, Data Abstraction, Encapsulation, Python Frameworks: Explore Django Framework.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O Reilly Publishers, 2017.
2. Dr. R. Nageswara Rao, "Core Python Programming", 3rd edition revised and updated, Dream tech Press, 2022.
3. Vamsi Kurama, "Python Programming: A Modern Approach", Kindle Edition, Pearson Publication, 2018.
4. Kenneth A. Lambert, Martin Osborne, "Fundamentals of Python: First program, Introduction to Python", Course Technology Cengage, Edition: import, 2011.
5. John V.Guttg, "Introduction to Computation and Programming using Python", MIT press, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1			3											3
2			3											3
3	3	3												3
4		3	3											3
5											3		3	
CO	3	3	3								3		3	3

22CAB06 DATABASE MANAGEMENT SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objective:

- To understand how a real world problem can be mapped to schemas
- To solve different industry level problems & to learn its applications

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze a given database application scenario to use ER model for conceptual design of the database	Ap	20%
CO2	Apply SQL to find solutions to a broad range of queries	Ap	20%
CO3	Apply normalization techniques to improve database design	Ap	20%
CO4	Apply principles of database transaction management, database recovery, and security.	C	20%
CO5	Develop, install and configure a database management system for business application and formulate queries to access the database.	C	20%

UNIT I - INTRODUCTION TO DATABASE SYSTEMS	**(9)**
Introduction to database systems – Definition of DBMS- Advantages of DBMS – Views of data – Levels of data Abstraction – Data Models and types – Database architecture – Entity Relationship Model – ER diagram – EER MODEL.	
UNIT II - RELATIONAL DATA MODEL	**(9)**
Relational database structure – Procedural and Non procedural languages – Relational algebra : operations - Integrity Constraints – SQL Commands : DDL – DML – TCL –DCL Set operations – Join Operations - Aggregation in SQL - Using the group by clause.	
UNIT III - SQL AND PL/SQL	**(9)**
PL/SQL Block – Introduction to PL/SQL – The Advantages of PL/SQL - PL/SQL Architecture - PL/SQL Data types - Variable and Constants – Using Built-in Functions – Conditional and Unconditional Statements – Stored procedures – Procedure with Parameters (IN,OUT and IN OUT) – Procedure with Cursors – Dropping a Procedure. Functions in PL/SQL : Difference between Procedures and Functions – User Defined Functions – Nested Functions –Using stored function in SQL statements – Trigger – Types of Triggers – Row Level Triggers – Statement Level Triggers –DDL Triggers.	
UNIT IV - DEPENDENCY PRESERVATION AND DB DESIGN	**(9)**
Functional Dependency: Full Functional Dependency - Partial dependency – Transitive dependency - Multi Valued Dependency – Decomposition – Normalization – Normal Forms: 1 NF- 2 NF – 3 NF – BCNF - 4 NF- 5 NF.	
UNIT V - TRANSACTIONAL PROCESSING	**(9)**
Transaction – Properties of transaction – Transaction state – Serialization : types – Need for Serialization – Two Phase Commit – Save Point – Concurrency – Locking protocols – Time stamp protocol – Next Generation Databases : No SQL, New SQL and Big Data – Document Databases – Data Models and Storage – No SQL APIs.	
	TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Abraham Silber Schatz, Henry F. Korthand S.Sudarshan,"Database System Concepts", 7th Edition, McGraw Hill, 2020.
2. Elmasri R, S. V. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson, New Delhi, 2017.
3. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Third Edition, McGraw Hill, New Delhi, 2003.
4. C. J. Date, "An Introduction to Database Systems", 8th Edition, Addison Wesley, 2006.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1			3										3	
2		3											3	
3		3												3
4			3											3
5											3			3
CO		**3**	**3**								**3**		**3**	**3**

22CAP01 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY				
	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

Course Objective:	• To demonstrate the concepts of Stack, Queue, Linked List and solving Applications for given problems • To Analyze and demonstrate Trees, Graphs, Searching and Sorting

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply concepts of Stack, Queue, Linked List.	Ap	20%
CO2	Analyze and demonstrate concepts of Tree and Graph.	An	20%
CO3	Demonstrate the Sorting Algorithms.	Ap	20%
CO4	The students will be able to demonstrate Searching and Sorting Techniques.	An	20%
CO5	The students will be able to code to implement object oriented paradigm	Ap	20%

List of Experiments (Implementation using Python)

1. Array implementation of Stack and Queue ADTs.
2. Linked list implementation of Stack and Queue ADTs.
3. Applications of Stack ADT.
4. Implementation of Binary Search Trees.
5. Implementation of AVL Trees.
6. Graph representation and Traversal Algorithms.
7. Given a graph with appropriate weights for each node, find the single source shortest path using Dijkstra's algorithm.
8. To implement Merge Sort and Quick Sort.
9. Given a program to implement 0/1 Knapsack using Dynamic Programming.
10. Given the Eight Queens Puzzle Problem of placing Eight Chess Queens on an 8×8 Chessboard so that no two queens attack each other.

TOTAL (P:60) :60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	2							2		2	
2	3	3	3	2				2			2		2	
3	3	3	3	2				2		2		3		2
4	3	3	3	2						2		3		2
5	3	3	3	2						2	2		2	
CO	**3**	**3**	**3**	**2**				**2**		**2**	**2**	**3**	**2**	**2**

22CAP02 DATABASE MANAGEMENT SYSTEMS LABORATORY					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PREREQUISITE : NIL					
Course Objective:	• Develop and implement efficient database schemas using Entity-Relationship (ER) diagrams and relational models. • To design and implement database applications on their own.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Implement the basic knowledge of SQL queries and relational algebra.	An	20%
CO2	Construct database models for different database applications.	Ap	20%
CO3	Apply normalization techniques for refining of databases.	Ap	20%
CO4	Practice various triggers, procedures, and cursors usingPL/SQL.	App	20%
CO5	Implement appropriate exception handling mechanisms in SQL and database operations to manage errors gracefully and maintain application stability.	C	20%

List of Experiments

1. Creation of a database and writing SQL queries to retrieve information from the database.
2. Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.
3. Creation of Views, Synonyms, Sequence, Indexes, Save point.
4. Creating an Employee database to set various constraints.
5. Creating relationship between the databases.
6. Write a PL/SQL block to satisfy some conditions by accepting input from the user.
7. Write a PL/SQL block that handles all types of exceptions.
8. Creation of database Triggers and Functions.

TOTAL (P:60) :60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1			3										3	
2			3										3	
3		3												3
4				3										3
5									3					3
CO		**3**	**3**	**3**					**3**				**3**	**3**

22CAE01 ENGLISH FOR PRAGMATIC USAGE					
		L	T	P	C
		0	0	2	1
PREREQUISITE : NIL					
Course Objective:	• To enable the students to incorporate the correct usage of grammar in communication • To improve the communicative competence through various discourse				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Demonstrate proficiency in grammar, syntax, and sentence structure in their writing, informed by their learning experiences.	U	40%
CO2	Develop adequate speaking skills to convey information effectively and present information logically and coherently, ensuring clarity and engagement.	R	30%
CO3	Develop well-organized and logically structured writing precisely and creatively.	Ap	30%

UNIT I – GRAMMAR	**(10)**
Verb - Tenses - Subject Verb Agreement - Error Spotting - Sentence Completion - Conditional Clauses.	
UNIT II - JOB REQUISITES	**(10)**
Self Introduction - Mini Presentation - Team Building Practices - Facing Interview Panel - Answering Familiar Questions - Company Profile - Stress Interviews - Group Discussion.	
UNIT III - WRITING NUANCE	**(10)**
Email Writing and Netiquettes - Job Application and Resume - Passage Writing (Topic & Picture Description) - Technical Report (Project Report)	
	TOTAL (P:30) :30 PERIODS

REFERENCES:

1. Rizvi, Ashraf M. *Effective Technical Communication* Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
2. Sudharshana, N.P and Saveetha.C. *English for Technical Communication* Cambridge University Press, New Delhi, 2017. .

Mapping of COs with POs / PSOs														
Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1					2	3								
2					2	3								
3					2	3								
CO					2	3								

22CAA01- PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To understand the mathematical concept of probability and random variable in various distributions. • To understand the concepts of testing the hypothesis of large and small samples and experiment of design.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply probability axioms and the moments of discrete and continuous random variables to core engineering problems.	Ap	20%
CO2	Solve the concepts of discrete probability distributions including requirements of mean and variance for decision making in algorithms.	Ap	20%
CO3	Determine the correlation and linear regression with respect to random variables in data science.	An	20%
CO4	Analyze large and small sample tests to perform non-parametric tests and design of experiment.	An	20%
CO5	Interpret the logical concepts in engineering design using effective mathematical tool.	Ap	20%

UNIT I - PROBABILITY AND RANDOM VARIABLES	**(9)**
Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties.	
UNIT II - STANDARD DISTRIBUTIONS	**(9)**
Discrete Distributions: Binomial, Poisson and Geometric. Continuous Distribution: Uniform and Normal Distributions.	
UNIT III - TWO DIMENSIONAL RANDOM VARIABLES	**(9)**
Joint Distributions - Marginal and Conditional Distributions – Covariance - Correlation and Regression.	
UNIT IV - TESTING OF HYPOTHESIS	**(9)**
Sampling Distributions -Testing of Hypothesis for Mean, Variance. t - Distribution, F – Distribution - Chi-Square Test for Independence of Attributes and Goodness of fit.	
UNIT V - DESIGN OF EXPERIMENTS	**(9)**
Analysis of Variance- Completely Randomized Design - Randomized Block Design - Latin Square Design.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Veerarajan T, "Probability and Statistics, Random Processes and Queuing Theory and Queuing Networks", 4th Edition, Tata McGraw-Hill, New Delhi 2018.
2. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2020.
3. Allen, O. Arnold, "Probability, Statistics and Queuing Theory with Computer Applications", 2nd ed., Elsevier, New Delhi, 1990.
4. Taha, H.A., "Operations Research - An Introduction", Pearson Education, New Delhi, 2017.
5. Trivedi, S. K, "Probability and Statistics with Reliability, Queuing and Computer Science Applications", John Wiley & Sons, New Delhi, 2008.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3		2												
4		2												
5	3				2				3			2		
CO	**3**	**2**			**2**				**3**			**2**		

22CAB07 DATA MINING AND DATA WAREHOUSING				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22CAB06

Course Objective:	• To determine the concepts of Data Mining, the importance of data cleaning and data preprocessing., Analyze various classification and clustering • To discuss various patterns, various Data Warehousing design and its usage

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of Data Mining and various types of data that can be mined.	Ap	20%
CO2	Apply the concepts of Preprocessing and to gain awareness about the importance of data cleaning.	Ap	20%
CO3	Analyze about the various classification methods and the evaluation of clustering.	An	40%
CO4	Apply various patterns in data mining.	Ap	20%
CO5	Acquire knowledge about various data warehousing design and its usage.	U	Internal Assessment

UNIT I - INTRODUCTION TO DATA MINING	**(9)**
Data Mining Definition - Why Data Mining - Types of Data can be Mined – Patterns – Technologies - Applications-Issues in Data Mining - Data Objects and Attribute Types - Basic Statistical Descriptions of Data - Data Visualization - Measuring Data Similarity and Dissimilarity - Case Study.	
UNIT II - DATA PREPROCESSING	**(9)**
Data Preprocessing: An Overview - Data Cleaning - Data Integration - Data Reduction - Data Transformation and Data Discretization.	
UNIT III - CLASSIFICATION AND CLUSTERING	**(9)**
Classification: Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule Based Classification– Model Evaluation and Selection. Clustering: Analysis – Partitioning, Hierarchical, Density Based Methods and Grid Based Methods – Evaluation of Clustering.	
UNIT IV - PATTERN MINING	**(9)**
Pattern Mining in Multilevel, Multidimensional Space - Constraint: Based Frequent Pattern Mining - Mining High Dimensional Data and Colossal Patterns - Mining Compressed Patterns - Pattern Exploration and Application.	
UNIT V - DATA WAREHOUSING	**(9)**
Data Warehouse: Basic Concepts - Data Warehouse Modeling Data Cube and OLAP - Data Warehouse Design and Usage – Implementation - Data Generalization- Case Study.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers, 2012.
2. George M. Marakas, "Modern Data Warehousing, Mining and Visualization: Core Concepts", Spring, 2012.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3												
2	2						2							
3		3									2			
4	2											2	2	
5			3	2									2	
CO	2	3	3	2			2				2	2	2	

22CAB08 PROGRAMMING IN JAVA					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To develop the ability to design, implement, and maintain robust, efficient, and scalable software applications using Java				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze core programming concepts such as syntax, data types and control structures.	An	20%
CO2	Applying OOP principles like encapsulation, inheritance, polymorphism, and abstraction, helps in creating modular, reusable, and maintainable code.	Ap	20%
CO3	Design applications that are portable across different operating systems and hardware.	Ap	20%
CO4	Enhance their problem-solving skills that analyze and optimize code performance to handle complex computational tasks effectively.	An	20%
CO5	Apply Generics, string handling, and the collection framework to equip with essential tools and techniques to write robust, efficient, and maintainable Java code.	Ap	20%

UNIT I - BASICS IN JAVA	**(9)**
History and Evolution of Java – An Overview of Java – Data Types, Variables, Type Conversions and Casting, Arrays – Operators – Control Statements - Command Line Arguments – Lambda Expressions.	
UNIT II - CLASSES AND OBJECTS, OVERLOADING	**(9)**
Introducing Classes : Class Fundamentals - Declaring Objects - Methods - Constructors - this Keyword - Garbage Collection – Overloading Methods and Constructors – Object as Argument and Returning Objects – Array of Objects –Recursion - Understanding Static – Final – Nested and Inner Class.	
UNIT III - INHERITANCE, PACKAGES AND INTERFACES	**(9)**
Inheritance Basics – Using Super – Method Overriding – Dynamic Method Dispatch – Abstract Classes –Using Final with Inheritance – Packages Member Access – Importing Packages – Interfaces – Using Static Methods in an Interface.	
UNIT IV - EXCEPTION HANDLING, MULTITHREADING AND I/O	**(9)**
Exception Handling Fundamentals – Exception Types – Using Try and Catch – Multiple Catch Clauses – Nested Try – Throw –Throws – Finally - Built-in Exceptions – User Defined Exceptions – Multithreaded Programming : Main Thread – Creating Threads - Thread Priorities – Synchronization – Inter Thread Communication – Enumeration - Type Wrappers – Auto boxing - I/O Basics : Buffered Input Stream – Buffered Output Stream – Print Stream – Print Writer- Reading and Writing a File.	

UNIT V - GENERICS, STRING HANDLING AND COLLECTION FRAMEWORK	(9)
Generic Class – Bounded Types – Generic Methods - String Handling : String Class –String Buffer and String Builder Class - Collection Frame works : Collection Interfaces – Collection Classes : Array List – Linked List – Hash Set – Tree Set – Priority Queue – Iterator – Map : Map Interfaces – Map Classes : Hash Map – Tree Map - Comparators.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Herbert Schildt, "Java: The Complete Reference", Eleventh Edition, Oracle Press, McGraw – Hill Education, 2019.
2. Cay S. Horstmann, "Core Java Volume I - Fundamentals", Tenth Edition, Prentice Hall, 2016.
3. Herbert Schildt, "Java : A Beginner's Guide", Seventh Edition, Oracle Press, McGraw – Hill Education, 2017.

TOTAL (L:45) : 45 PERIODS

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3												
3			3											
4			3							3			3	3
5										3	3	3	3	3
CO	3	3	3							3	3	3	3	3

22CAB09 BIG DATA ANALYTICS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• Apply big data analytics techniques to solve real-world problems, demonstrating the ability to derive actionable insights from complex data sets.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge about the basic terminology of Big Data Analytics.	Ap	20%
CO2	Knowledge of Data mining tool and practical experience of applying data mining algorithms.	Ap	20%
CO3	Design applications using NoSQL and HADOOP	Ap	20%
CO4	To recognize and make appropriate use of different types of data structures.	C	20%
CO5	Design and write functions in R and to create sophisticated figures and graphs.	C	20%

UNIT I – INTRODUCTION	**(9)**
Introduction – Characteristics and Considerations – Data Structures – Business drivers – Business intelligence Vs Data science – Analytical Architecture –Key Roles of the New Big Data Ecosystem – Data Scientist - Big Data Applications.	
UNIT II - DATA ANALYTICS LIFECYCLE & ADVANCED ANALYTICS THEORY AND METHODS	**(9)**
Data Analytics Lifecycle: Discovery – Data preparation – Model Planning – Model Building – Communicate results – Operationalize – Key Roles for a Successful Analytic Project – Case Studies. Association Rules: Apriori Algorithm – Applications of Association Rules - Regression: Linear Regression – Logistic Regression.	
UNIT III - NoSQL, HADOOP AND MAP REDUCE	**(9)**
Base Concept. NoSQL: Types of Databases – Advantages – NewSQL – SQL vs. NoSQL vs NewSQL. Introduction to Hadoop: Features – Advantages – Versions – Overview of Hadoop Eco systems – Hadoop distributions – Hadoop vs. SQL – RDBMS vs. Hadoop – Hadoop Components – Architecture – HDFS – Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression. Hadoop 2 (YARN): Architecture – Interacting with Hadoop Eco systems.	

UNIT IV - R PROGRAMMING	(9)
Overview – Environment Setup – Data Types – Variables – Operators – Decision Making – Loops Statements – Function – Strings – Vectors: Scalars, Recycling, Operations – Function: All and Any, Vectorized operations, NA and NULL values, Filtering , Vectorized if-then else, Vector Equality, Vector Element names. Lists: Creation, Operations – Accessing List Components and Values, Applying functions to lists, Recursive List. Matrices: Creation, Operations – Applying functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction- Avoiding Dimension Reduction, Higher Dimensional arrays.	
UNIT V - ARRAYS, DATAFRAMES, INTERFACING AND GRAPHICS	**(9)**
Arrays: Creating, Accessing, Manipulating Array Elements – Factors: Factors and Tables, Factors and Levels, Functions, Working with tables. Data Frames: Creation, Matrix-like Operations, and Merging Data frames – Applying functions to Data Frames. R Data Interfaces: CSV Files – Excel files – Databases. Graphics: Creating Graphs, Customizing Graphs, Saving graphs to files, Creating three-dimensional plots. Charts: Pie chart – Bar Chart – Box plots – Histograms – Line Graphs – Scatter plots.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons Publications.
2. Tom White, "Hadoop: The Definitive Guide", Third Edition, Oreilly Media, 2011.
3. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", NoStarch Press, 2011.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3											3	
2											3		3	
3											3			3
4		3												3
5											3			3
CO		3									3		3	3

22CAP03 PROGRAMMING IN JAVA LABORATORY					
		L	T	P	C
		0	0	4	2
PREREQUISITE : NIL					
Course Objective:	• To develop proficiency in Java programming with a focus on designing, implementing, and debugging Java applications across various domains and scenarios.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Develop proficiency in Core Java Concepts and Syntax	Ap	20%
CO2	Implement Object-Oriented Programming (OOP) Skills	Ap	25%
CO3	Implement advanced Java Programming Techniques	C	20%
CO4	Implement exception Handling and Robust Programming	Ap	15%
CO5	Design User Interface Development with AWT	C	20%

List of Experiments

1. Write a java Program with Multi- dimensional Array.
2. Write a java program to work with Operators and Control Structures.
3. Design a Java Program with Class and Objects and Constructors.
4. Write a Java Program to implement Overloading in Java.
5. Write a Java Program on Inheritance.
6. Write a Java Program to implement Runtime Polymorphism and Interfaces.
7. Design a java Program to implement the User-Defined Package.
8. Create a Java Program with Threads.
9. Write a Java Program to handle the Exception.
10. Create a web page using AWT.

TOTAL (P:60) :60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3											3		
2		3										3	3	
3			3								3	3	3	3
4			3								3	3		3
5			3								3	3	3	3
CO	**3**	**3**	**3**								**3**	**3**	**3**	**3**

22CAP04 BIG DATA ANALYTICS LABORATORY				
	L	T	P	C
	0	0	4	2

PREREQUISITE : NIL

Course Objective:

- Apply big data analytics techniques to solve real-world problems,

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Proficient the basic concepts of R programming	An	20%
CO2	Provide the solution to the real time problems.	Ap	20%
CO3	Analyze the data using different data mining algorithms.	Ap	20%
CO4	Apply the tool to visualize dataset for data analytics	Ap	20%
CO5	Develop the projects and provide the solution to the problems.	C	20%

List of Experiments

1. Use of Array and List
2. Use of Strings
3. Use of Matrices
4. Use of Vectors
5. Use of Function
6. Implement Discrete Distributions
7. Implement Continuous Distribution
8. Perform the Testing of Hypothesis
9. Visualize data using different Plots
10. Implement Association Rules
11. Implement Linear and Logistic Regression

TOTAL (P:60) :60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1		3											3	
2			3										3	
3			3											3
4											3			3
5									3					3
CO		**3**	**3**						**3**		**3**		**3**	**3**

22CAB10 MACHINE LEARNING				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives :

- Provides a concise introduction to the fundamental concepts of machine learning and popular machine learning algorithms.
- To discover patterns in the data and make predictions based on often complex findings to answer business questions, detect and analyze trends and help solve

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Illustrate the foundations of machine learning and apply suitable techniques for data collection and data processing.	Ap	20%
CO2	Select the appropriate model and use feature engineering	An	20%
CO3	To analyze data, model uncertainties, and make decisions based on statistical and probabilistic reasoning.	An	20%
CO4	Select appropriate task to build effective models whether to categorize data into discrete classes or to predict a quantity.	Ap	20%
CO5	Apply clustering to find a structure in a collection of unlabeled data and ANN to create complex patterns of a model and predict problems.	Ap	20%

UNIT I – INTRODUCTION	**(9)**
Human Learning - Types – Machine Learning - Types - Problems not to be solved - Applications - Languages/Tools– Issues. Preparing to Model: Introduction - Machine Learning Activities - Types of data - Exploring structure of data - Data quality and remediation - Data Preprocessing.	
UNIT II - MODEL EVALUATION AND FEATURE ENGINEERING	**(9)**
Model Evaluation: Model Selection - Training Model - Model Representation and Interpretability - Evaluating Performance of a Model - Improving Performance of a Model - Feature Engineering: Introduction - Feature Transformation – Feature Subset Selection.	
UNIT III – PROBABILITY AND BAYESIAN LEARNING	**(9)**
Importance of Statistic Tools – Concept of Probability-Random Variables - Discrete distributions-Continuous distributions- Multiple Random Variables. Bayesian Concept Learning: Bayes Theorem-Concept Learning- Bayesian Belief Network.	
UNIT IV - SUPERVISED LEARNING	**(9)**
Classification: Introduction-Example-Classification model-Learning steps- Common classification algorithms- K-Nearest Neighbor-Decision Tree-Random Forest Model - Support Vector Machines. Regression: Introduction-Example-Simple linear regression-Multiple linear regression-Assumptions and problems in Regression Analysis- Improving the accuracy.	

UNIT V - UNSUPERVISED LEARNING AND ARTIFICIAL NEURAL NETWORKS	(9)
Unsupervised Learning Vs Supervised Learning – Applications – Clustering - Biological Neuron - Artificial Neuron-Types of Activation Function-Architectures of NN – Learning process in ANN – Back Propagation. Reinforcement Learning.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Saikat Dutt, Subramanian Chandramouli and Amit Kumar Das, "Machine Learning", 1st Edition, Pearson Education, 2019.
2. AurelienGeron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition, O'Reilly, 2019.
3. Willi Richert, Luis Pedro Coelho, "Building Machine Learning Systems with Python", 2ndEdition, Packt Publishing Ltd., 2015.
4. T. Hastie, R. Tibshirani, J. H. Friedman, "Introduction to Statistical Machine Learning", First Edition, Springer, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3												
2		3												
3	3		3											
4										3	3		3	3
5										3	3		3	3
CO	3	3	3							3	3		3	3

22CAB11 WEB TECHNOLOGY					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To understand the fundamental web technologies • To develop practical skills for building web applications				
Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**		
CO1	Apply the necessary HTML elements to the Document's design.	An	20%		
CO2	Create Programs Using Scripting Language and CSS Presentation	Ap	40%		
CO3	Explore DOM concepts.	An	20%		
CO4	Develop XML and JSP Programs.	Ap	20%		
CO5	Implement React JS	C	Internal Assessment		

UNIT I - WEB ESSENTIALS	**(9)**
Clients, Servers and Communication : The Internet - Basic Internet Protocols - The World Wide Web - HTTP Request Message - Response Message - Web Clients - Web Servers - Markup Languages : HTML – History and Versions - Basic XHTML Syntax and Semantics – HTML Elements - Relative URLs – Lists – Tables – Frames –Forms - XML – Creating HTML Documents.	
UNIT II - STYLE SHEETS AND JAVASCRIPT	**(9)**
CSS – Features - Core Syntax - Style Sheets and HTML - Style Rule Cascading and Inheritance - Text Properties - Box Model – Normal Flow Box Layout - Client-Side Programming: The JavaScript Language- JavaScript in Perspective – Syntax - Variables and Data Types-Statements-Operators– Literals– Functions– Objects– Arrays -Built-in Objects-JavaScript Debuggers.	
UNIT III – DOM	**(9)**
DOM - DOM History and Levels - Intrinsic Event Handling - Modifying Element Style -The Document Tree - DOM Event Handling - Accommodating Noncompliant Browsers - Properties of Window.	
UNIT IV - XML AND JSP	**(9)**
XML - Documents and Vocabularies - Versions and Declaration - Namespaces - JavaScript and XML: Ajax - DOM based XML Processing- JSP Technology - JSP and Servlets - Running JSP Applications -Basic JSP-Tag Libraries and Files-Model-View- Controller Paradigm.	
UNIT V - REACT JS	**(9)**
Fundamentals of React JS – JSX – Components – Events – Lists – Forms – Styling React using CSS –Building a React Web Application.	
	TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Jeffrey C.Jackson, "Web Technologies - A Computer Science Perspective", 1st Edition, Pearson Education, 2015.
2. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", 5th Edition, Pearson Education, 2012.
3. Cory Gackenheimer, Introduction to React, Apress, 2015.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		3						3			3	3	2
2	3	3							3					
3	3		3										3	
4		3			3				3			3	3	3
5	3							3	3		3	3	3	
CO	3	3	3		3			3	3		3	3	3	2.5

22CAB12 CYBER SECURITY				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22CAB03

Course Objective:	• To develop graduates that can plan, implement, and monitor cyber security mechanisms to help ensure the protection of information technology assets. • A cyber security policy establishes the guidelines for data security activities such as encrypting emails, limiting access to critical systems, and maintaining data integrity.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Identify risk management processes, risk treatment methods, organization of information security.	Ap	20%
CO2	Explore the various tools and methods used in security controls.	An	20%
CO3	Classify cyber security solutions and network management.	Ap	20%
CO4	Examine software vulnerabilities and security solutions to reduce the risk of exploitation.	An	20%
CO5	Analyze the cyber security needs of a Security assessment.	An	20%

UNIT I – PLANNING FOR CYBER SECURITY	**(9)**
Introduction - Standards and a Plan of Action - Security Governance Principles, Components and Approach - Information Risk Management - Asset Identification - Threat Identification - Vulnerability Identification - Risk Assessment Approaches - Likelihood and Impact Assessment - Risk Determination, Evaluation and Treatment - Security Management Function - Security Policy - Acceptable Use Policy - Security Management.	
UNIT II – SECURITY CONTROLS	**(9)**
People Management - Human Resource Security - Security Awareness and Education - Information Management - Information Classification and handling – Privacy - Documents and Record Management - Physical Asset Management - Office Equipment - Industrial Control Systems - Mobile Device Security - System Development - Incorporating Security into SDLC Case study on information security policies.	
UNIT III - CYBER SECURITY FOR BUSINESS APPLICATIONS AND NETWORKS	**(9)**
Business Application Management - Corporate Business Application Security - End user Developed Applications - System Access - Authentication Mechanisms - Access Control - System Management - Virtual Servers - Network Storage Systems - Network Management Concepts - Firewall-IP Security - Electronic Communications – Case study on OWASP vulnerabilities using OWASP ZAP tool.	
UNIT IV - TECHNICAL SECURITY	**(9)**
Supply Chain Management - Cloud Security - Security Architecture - Malware Protection - Intrusion Detection - Digital Rights Management - Cryptographic Techniques - Threat and Incident Management - Vulnerability Management - Security Event Management - Forensic Investigations -Local Environment Management - Business Continuity – Case study on cloud and cryptographic vulnerabilities.	
UNIT V - SECURITY ASSESSMENT	**(9)**
Security Monitoring and Improvement - Security Audit - Security Performance - Information Risk Reporting - Information Security Compliance Monitoring - Security Monitoring and Improvement Best Practices – Case study on vulnerability assessment using ACUNETIX.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. William Stallings, "Effective Cyber Security-A guide to using Best Practices and Standards", Addison-Wesley Professional, First Edition, 2018.
2. Adam Shostack, "Threat Modelling- Designing for Security", Wiley Publications, First Edition, 2014.
3. Gregory J. Touhill and C. Joseph Touhill, "Cyber Security for Executives- A Practical Guide", Wiley Publications, First Edition, 2014.
4. RaefMeeuwisse, "Cyber Security for Beginners", Second Edition, Cyber Simplicity Ltd, 2017.
5. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Second Edition, Syngress, 2013.
6. OWASP ZAP : https://owasp.org/www-project-zap/ACUNETIX: https://www.acunetix.com/

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3	3											3	
3		3	3											3
4				3									3	
5							3							
CO	3	3	3	3			3						3	3

22CAP05 MACHINE LEARNING LABORATORY				
	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

Course Objectives :	• Learn to create, manipulate, and analyze datasets using pandas and numpy libraries in Python. • Gain skills in data cleaning, exploration, and basic data manipulation techniques. • Designed to provide a comprehensive foundation in data analysis, statistical methods, and machine learning techniques using Python.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Manipulate datasets using pandas and numpy including data cleaning, transformation, and basic exploratory data analysis.	An	10%
CO2	Analyze the relationships between numerical variables, enhancing their descriptive statistics skills.	An	10%
CO3	Apply a variety of data preprocessing techniques such as handling missing values, normalization, scaling, and encoding to improve data quality and model performance.	Ap	30%
CO4	Apply supervised to various types of data and interpret their results.	Ap	30%
CO5	Apply unsupervised algorithms to various types of data and interpret their results.	Ap	20%

LIST OF EXPERIMENTS

1. Exploration of a Data Set in the IDE and create dataset and perform pandas and numpy operations.
2. Python program to calculate mean, median, variance, standard deviation and exploring relationship between variables of the given numerical data.
3. Implementation of various data preprocessing techniques on real time dataset.
4. Program to implement Naïve Bayes Classifier Algorithm using Python.
5. Program to find the attribute with maximum information gain and gain ratio and construct the decision tree for the given data using Python.
6. Program to implement Random Forest Algorithm and K-NN algorithm using Python.
7. Program to implement Support Vector Machines learning algorithm using Python.
8. Python program to implement Simple Linear regression, Multi Linear regression and Logistic Regression algorithms.
9. Program to implement K-Means Clustering algorithm using Python.
10. Program to implement multi-layer Artificial Neural Network using Python.

TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3												
2	3													
3		3	3							3	3	3		
4			3							3	3	3	3	3
5			3							3	3	3	3	3
CO	3	3	3							3	3	3	3	3

22CAP06 WEB TECHNOLOGY LABORATORY				
	L	T	P	C
	0	0	4	2

PREREQUISITE : NIL

Course Objective:	• Design and develop web pages using HTML, CSS, and React JS, with proper alignment, styling, and validation. • Understand and apply scripting languages and XML to store and validate data, and create interactive web applications.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Display webpage using HTML tags	Ap	20%
CO2	Know image map concepts	An	20%
CO3	Validate fields using scripting languages	Ap	20%
CO4	Store data using XML program	An	20%
CO5	Program using React JS	C	20%

LIST OF EXPERIMENTS

1. Create a HTML page, which has properly aligned paragraphs with image along with it.
2. Write a program to display list of items in different styles.
3. Create both client side and server side image maps.
4. Create your own style sheets and use them in your web page.
5. Create a form with various fields and appropriate front and validations using any one of the scripting languages.
6. Create a web page using XML.
7. Create React JS program to validate user input.
8. Develop a program for User Registration Form using React JS.
9. Develop a web application project using React JS.

TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	3	3								3	3
2	3		3										3	
3													3	
4							2			3			3	3
5		3		3	3		2			3				3
CO	**3**	**3**	**3**	**3**	**3**		**2**			**3**			**3**	**3**

22CAE02 MINI PROJECT				
	L	T	P	C
	0	0	4	2

PREREQUISITE : NIL

Course Objective:	• To apply theoretical knowledge to practical to the real-world problems and enhance students' technical skills in their respective fields of study. • To develop critical thinking, problem-solving skill, innovation, creativity in approaching and solving project-related challenges.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Identify the problem and analyze the project requirements	An	10%
CO2	Apply current techniques and software tools necessary for solving complex modules.	Ap	15%
CO3	Improve their individuality and work as team player	Ap	15%
CO4	Show their individuality and inspiration in the mini project by designing a specific to real time applications	C	20%
CO5	Interpret data and synthesis the information to derive conclusion for implementation of project.	C	20%

DESCRIPTION

The Mini Project may be allotted to a single student or to a group of students not exceeding four per group. The Head of the department shall constitute a project review committee for the mini project. The title of the project is approved by head of the department under the guidance of the project review committee. Student(s) shall prepare a comprehensive project report after completing the work to the satisfaction of the guide. There shall be three reviews during the semester and the progress will be reviewed by the committee. Student(s) shall make presentation on the progress made by him / her / them before the committee and evaluation is done as per regulations.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1		3											3	
2		3											3	
3								3						3
4			3											3
5												3		3
CO		**3**	**3**					**3**				**3**	**3**	**3**

22CAE03 PROJECT WORK				
	L	**T**	**P**	**C**
	0	**0**	**24**	**12**

PREREQUISITE : 22CAE02

Course Objective:	• To acquire knowledge by applying various techniques in plan, analyze, design and implement software project. • Apply programming language concepts and choose from various software developments process models appropriate for project. • Apply principles such as cost estimation and time estimation for project, focus on getting the working project done on time, demonstrate ability to communicate and do document effectively.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Engage in independent study to research literature in the identified area and consolidate the literature search to identify and formulate the problem of software application.	An	10%
CO2	Planning the schedule for project to analyze, design, implementation of software project.	Ap, E	15%
CO3	Implementation of project by selecting the programming languages, software tools / components required and demonstrates the project.	An, C	15%
CO4	Engage in effective written communication through the project report, effective oral communication through presentation of the project work and demonstration of project.	E	25%
CO5	Demonstrate compliance to the prescribed standards or safety norms and abide by the norms of professional ethics and clearly specify the outcome of the project work.	Ap, An	35%

DESCRIPTION

The Project Work may be allotted to a single student. The Head of the department shall constitute a project review committee for the project work. The title of the project is approved by head of the department under the guidance of the project review committee. Student(s) shall prepare a comprehensive project report after completing the work to the satisfaction of the guide. There shall be three reviews during the semester and the progress will be reviewed by the committee. Student(s) shall make presentation on the progress made by him / her before the committee and evaluation is done as per regulations.

TOTAL (P:24x15)= 360 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3		3						3				
2	3	3	3			3	2		3		3		3	2
3		3	3				2	2		3		3		2
4						3		2			3			
5						3	2	2	3				3	
CO	**3**	**3**	**3**	**3**		**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**

Professional Electives - Artificial Intelligence and Data Science

22CAX01 INTERNET OF THINGS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• To introduce students to the fundamentals of electrical and electronic devices, IoT, Arduino, and Raspberry Pi. • To enable students to design and implement IoT systems using Arduino and Raspberry Pi.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Explain basics of electrical circuits, electronic devices, and IoT characteristics	An	20%
CO2	Describe working of Arduino and Raspberry Pi, including Analog and Digital I/O pins, communication protocols, and programming	Ap	40%
CO3	Analyze IoT applications, including home automation, smart parking, weather monitoring, and smart irrigation.	An	20%
CO4	Design and implement IoT systems using Arduino and Raspberry Pi	Ap	20%
CO5	Implement IoT systems for real-time applications, such as home automation, smart parking, weather monitoring, and smart irrigation..	C	Internal Assessment

UNIT I - BASIC ELECTRONICS	**(9)**
Introduction - Current, Voltage and Resistance - Analog and Digital Signal - Conductors Vs Insulators – KCL- KVL - Basic Electronics components - calculating equivalent resistance for series and parallel circuits- Ohm's law- Color coding for a resistor – LED – LCD – LDR - Case Studies.	
UNIT II - FUNDAMENTALS OF IOT	**(9)**
Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT Communication Models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry - Case Studies.	
UNIT III - PROGRAMMING USING ARDUINO	**(9)**
Introduction to Arduino processor- General Block diagram- Working of Analog and Digital I/O pins- Serial (UART), I2C Communications and SPI communication - Arduino Boards: Mega, Due, Zero and 101 - Prototyping basics - Technical description - Setting Up Arduino IDE- Introduction to Arduino programming - Case Studies.	
UNIT IV - PROGRAMMING USING RASPBERRY PI	**(9)**
Technical Description of Raspberry Pi - comparison of Raspberry Pi Vs Arduino - Operating Systems for RPi - Preparing SD Card for Pi - Connecting Raspberry Pi as PC - Exploring Raspberry Pi Environment- Logical design using Python - Case Studies.	

UNIT V - APPLICATIONS OF IOT	(9)
Various Real time applications of IoT- Home Automation - Smart Parking - Environment: Weather monitoring system - Agriculture: Smart irrigation – Domain Specific applications - Case Studies.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A Hands-on Approach", Universities Press, 2015.
2. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, 2006.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley Publications, Second Edition, 2013.
4. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.
5. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publications, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3		3			3	3	3			3	3	
2	3		3										3	
3		3	3					3					3	3
4		3					3					3	3	
5		3		3			3	3	3			3	3	3
CO	3	3	3	3			3	3	3			3	3	3

22CAX02 ARTIFICIAL INTELLIGENCE				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand the fundamental concepts and characteristics of Intelligent Agents, problem-solving methods, knowledge representation, and software agents in Artificial Intelligence. • To apply AI concepts to design and develop intelligent systems, including search strategies, knowledge representation, software agents, and applications in Natural Language Processing and other areas.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze AI concepts and characteristics	An	20%
CO2	Apply AI concepts to solve problems and design systems	Ap	40%
CO3	Analyze knowledge representation and software agents	An	20%
CO4	Apply AI concepts to develop intelligent systems and applications	Ap	20%
CO5	Design and develop innovative AI-powered NLP applications	C	Internal Assessment

UNIT I – INTRODUCTION	**(9)**
Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.	
UNIT II - PROBLEM SOLVING METHODS	**(9)**
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games.	
UNIT III - KNOWLEDGE REPRESENTATION	**(9)**
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories -Reasoning with Default Information.	
UNIT IV - SOFTWARE AGENTS	**(9)**
Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	
UNIT V – APPLICATIONS	**(9)**
AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. S. Russeland, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2009.
2. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: A Logical Approach", Oxford University Press, 2004.
3. G. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Fourth Edition, Pearson Education, 2002.
4. J. Nilsson, "Artificial Intelligence: A New Synthesis", Elsevier Publishers, 1998.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3	3											3	
3			3										3	3
4	3	3	3										3	
5		3	3							3	3		3	3
CO	3	3	3							3	3		3	3

22CAX03 ROBOTIC PROCESS AUTOMATION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• Design and develop robotic process automation (RPA) solutions using various tools and techniques, including desktop and web recording, data scraping, and image and text automation. • Deploy and maintain RPA bots, handle user events and exceptions, and publish and manage updates using server and package management.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Record and automate processes using desktop and web recording	An	20%
CO2	Scrape data and automate tasks using selectors and advanced techniques	Ap	40%
CO3	Handle user events and exceptions using assistant bots and debugging tools	An	20%
CO4	Deploy and maintain RPA bots using server and package management	C	Internal Assessment
CO5	Publish and manage updates, and troubleshoot issues using debugging strategies.	An	20%

UNIT I - BASICS OF ROBOTIC PROCESS AUTOMATION	**(9)**
Scope and techniques of automation, Robotic process automation - Benefits of RPA, Components of RPA, RPA platforms, The future of automation. History of Automation - RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - Processes can be Automated - Types of Bots - Workloads 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.	
UNIT II - RPA TOOL	**(9)**
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 - 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 - Assign Activity - Delay Activity - Do While Activity - If Activity -Switch Activity - While Activity - For Each Activity - Break Activity - Data Manipulation Introduction - Scalar Variables, Collections and Tables - Text Manipulation - Data Manipulation - Gathering and Assembling Data.	
UNIT III - ADVANCED AUTOMATION CONCEPTS & TECHNIQUES	**(9)**
Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization – Debugging - Dynamic Selectors - Partial Selectors - 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.	

UNIT IV - HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING	(9)
Assistant bots - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event. Exception Handling: Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.	
UNIT V - DEPLOYING AND MAINTAINING THE BOT	**(9)**
Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating a provision Robot from the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.
2. Kelly Wibbenmeyer, "The Simple Implementation Guide to Robotic Process Automation (RPA): How to Best Implement RPA in an Organization", Universe, 2018.
3. Richard Murdoch, "Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant", Independently Published, First Edition 2018.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3							3		3		3	
2			3						3					
3		3								3		3		
4	3		3						3	3		3	3	3
5	3	3	3						3	3	3	3	3	
CO	3	3	3						3	3	3	3	3	3

22CAX04 NATURAL LANGUAGE PROCESSING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To provide a comprehensive understanding of fundamental and advanced concepts in Speech and Language Processing.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Comprehensive understanding of NLP Concepts	An	20%
CO2	Gain experience in developing and implementing NLP models and algorithms.	Ap	20%
CO3	Analyze techniques to optimize and enhance the performance of NLP models.	An	20%
CO4	Applying NLP techniques to solve real-world problems across various domains, such as information retrieval, customer service automation, and content generation.	Ap	20%
CO5	Apply innovative approaches to address emerging challenges and opportunities in natural language processing	Ap	20%

UNIT I – INTRODUCTION	**(9)**
Knowledge in Speech and Language Processing – Ambiguity- Models and Algorithms - Regular Expressions & Finite State Automata: Regular Expressions – Automata - Disjunction, Grouping, and Precedence- Advanced Operators - Formal Languages – Non-Deterministic FSAs – sing an NFSA to Accept Strings – Recognition as Search – Relating Deterministic and Non-Deterministic Automata – Regular Languages and FSAs.	
UNIT II - WORDS AND TRANSDUCERS	**(9)**
Survey of English Morphology - Inflectional Morphology - Derivational Morphology – Cliticization - Non-Concatenative Morphology – Agreement - Finite-State Morphological Parsing - Construction of a Finite-State Lexicon - Finite-State Transducers - Sequential Transducers and Determinism - FSTs for Morphological Parsing - Transducers and Orthographic Rules – Lexicon-Free FSTs: Word and Sentence Tokenization - Segmentation in Chinese -Detection and Correction of Spelling Errors - Minimum Edit Distance – Human Morphological Processing.	
UNIT III - N-GRAMS AND PART OF SPEECH TAGGING	**(9)**
Word Counting in Corpora - Simple (Unsmoothed) N-grams - Training and Test Sets - N-gram Sensitivity to the Training Corpus - Unknown Words: Open Versus Closed Vocabulary Tasks - Evaluating N-grams - Perplexity - Smoothing - Laplace Smoothing. Part-of-Speech Tagging: Rule-Based Part-of-Speech Tagging - HMM Part-of-Speech Tagging - Transformation-Based Tagging - Evaluation and Error Analysis - Advanced Issues in Part-of-Speech Tagging.	
UNIT IV - PHONETICS AND SPEECH SYNTHESIS	**(9)**
Speech Sounds and Phonetic Transcription - Articulatory Phonetics - Phonological Categories and Pronunciation Variation - Acoustic Phonetics and Signals - Phonetic Resources - Advanced: Articulatory and Gestural Phonology. Speech Synthesis: Text Normalization - Phonetic Analysis - Prosodic Analysis - Diphone Waveform synthesis - Unit Selection (Waveform) Synthesis.	

UNIT V - AUTOMATIC SPEECH RECOGNITION AND SYNTACTIC PARSING	(9)
Speech Recognition Architecture - Feature Extraction: MFCC vectors - Acoustic Likelihood Computation - The Lexicon and Language Model - Search and Decoding - Context-Dependent Acoustic Models: Triphones - Modeling Variation. Computational Phonology: Finite State Phonology - Learning Phonology and Morphology. Syntactic Parsing: Parsing as Search - Search in the Face of Ambiguity - Dynamic Programming Parsing Methods - Partial Parsing.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Pearson Publication, India, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", 1st Edition, OReilly Media, 2009.
3. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", 2nd Edition, Chapman and Hall/CRC Press, 2010.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3	3												
3		3	3								3		3	
4		3	3								3	3	3	3
5		3	3				3				3	3	3	3
CO	3	3	3				3				3	3	3	3

22CAX05 DATA CENTER VIRTUALIZATION				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• Establish a thorough understanding of virtualization principles, hypervisors, and VMware vSphere, which are critical for effectively utilizing and managing virtualized data center environments.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Describe virtualization and server virtualization platform.	Ap	20%
CO2	Analyze the functions of virtual machine and deploy vCenter Server Management	Ap	20%
CO3	Apply the virtualization techniques for the communication between devices across different office and data center locations.	Ap	20%
CO4	Design and create the working of virtual machines.	C	20%
CO5	Design and create e about securing, monitoring and automating of VMware.	C	20%

UNIT I - INTRODUCTION TO VIRTUALIZATION	**(9)**
Understanding Virtualization: Describing Virtualization, Understanding the Importance of virtualization, Understanding virtualization software operation. Understanding Hypervisors: Describing a Hypervisors, Understanding the Role of a Hypervisor, Comparing today's Hypervisors. Introducing VMware vSphere 6: Exploring VMware vSphere 6.0, Planning a VMware vSphere Deployment, Deploying VMware ESXi, Performing post installation configuration.	
UNIT II - VMWARE VCENTER SERVER	**(9)**
Installing and Configuring vCenter Server: Introducing vCenter Server, Choosing the version of vCenter server, planning and designing a vCenter server deployment, Installing vCenter server and its components, Installing vCenter server in a linked mode group, Deploying the vCenter server virtual appliance, exploring vCenter Server, creating and managing a vCenter Server Inventory, Exploring vCenter servers management features, Managing vCenter Server settings, vSphere web client administration.	
UNIT III - CREATING AND CONFIGURING VIRTUAL NETWORKS	**(9)**
Introduction to Virtual Network, Working with vSphere Standard Switches, Working with vSphere Distributed switches, Examining Third-Party distributed virtual switches, Configuring virtual switch security. Implementing vSphere Storage Fundamentals: vSphere storage concepts, understanding virtual volumes, SCs vs. LUNs, storage policies, Virtual volumes, Working with VMFS Datastores, Raw device mappings, NFS	
UNIT IV - WORKING WITH VIRTUAL MACHINES	**(9)**
Creating and Managing Virtual Machines: Understanding Virtual Machines, Creating a Virtual Machine, Installing a guest Operating System, Installing VMware tools, Managing Virtual Machines, Modifying Virtual Machines, Cloning VMs, Creating templates and deploying Virtual Machines, Using OVF templates, Using content libraries, Working with vApps, Importing machines from other environments. Configure and maintain a vCloud Air Connection: Create a VPN connection between vCloud Air and On-premise site, Deploy a Virtual Machine using vCloud Air, Migrate a virtual machine to vCloud Air, Verify VPN connection configuration to vCloud Air, Configure vCenter Server Connection to vCloud Air.	

UNIT V - SECURING AND MONITORING	(9)
Securing VMware vSphere: Overview of vSphere security, Securing ESXi Hosts, Securing vCenter Server, Securing virtual machines. Monitoring VMware vSphere Performance: Overview of performance monitoring, Alarms, Working with performance charts, Monitoring CPU, Memory, Network and Disk usage. Automating VMware vSphere: Advantages of Automation, vSphere automation options, Automation with Power CLI, Using vCLI from vSphere management assistant, Using vSphere management assistant for automation with vCenter , ESXCLI and PowerCLI.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Nick Marshall, "Mastering VMware vSphere 6 (SYBEX) (Paperback)", Grant Orchard. ISBN: 978-1-118-92515-7.
2. John A. Davis, Steve Baca, "VCP6-DCV Official Cert Guide (Exam #2V0-621) (Paperback)", ISBN-13: 978-9332581265
3. G. B. Abhilash, "VMware vSphere 6.5 Cookbook: Over 140 task-oriented recipes to install, configure, manage, and orchestrate various VMware vSphere 6.5 components", 3rd Edition.
4. Matthew Portnoy, "Virtualization Essentials (Paperback)".
5. Andrea Mauro, Paolo Valsecchi, Karel Novak, "Mastering VMware vSphere 6.5".
6. Martin Hoskenr, "VMware Software-Defined Storage Paperback".
7. Tony Sangha and Bayu Wibowo, "VMware NSX Cookbook".

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3											3	
2			3										3	
3		3												3
4		3												3
5											3			3
CO		3	3								3		3	3

22CAX06 SOCIAL NETWORK ANALYSIS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• Understand the fundamentals of social network data analytics, including statistical properties, community discovery, and node classification. • Apply social network data analytics techniques to real-world problems, including social influence analysis, link prediction, visualizing and mining, and multimedia information networks.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Explain statistical properties and measures of social networks	An	20%
CO2	Apply methods and algorithms for community discovery and node classification	Ap	40%
CO3	Survey social influence analysis and link prediction techniques	An	20%
CO4	Apply visualization and mining techniques in social networks	Ap	20%
CO5	Utilize multimedia information networks in social media	C	Internal Assessment

UNIT I – SOCIAL NETWORK DATA ANALYTICS	**(9)**
Introduction - Statistical Properties of Social Networks: Preliminaries – Static Properties - Dynamic Properties – Random Walks on Graphs: Background – Random Walk based Proximity Measures - Other Graph - Based Proximity Measures – Graph – Theoretic Measures for Semi-Supervised Learning - Clustering with Random Walk based Measures.	
UNIT II - COMMUNITY DISCOVERY AND NODE CLASSIFICATION	**(9)**
Communities in Context - Core Methods: Quality Functions - The Kernighan -Lin(KL) Algorithm – Agglomerative / Divisive Algorithms - Spectral Algorithms - Multi-Level Graph Partitioning - Markov Clustering – Emerging Fields and Problems - Node Classification in Social Networks: Problem Formulation - Methods using Local Classifiers - Random Walk based Methods - Applying Node Classification to Large Social Networks Variations on Node Classification.	
UNIT III - SOCIAL INFLUENCE ANALYSIS AND LINK PREDICTION	**(9)**
Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Expert Location in Social Networks: Expert Location without Graph Constraints - Expert Location with Score Propagation – Expert Team Formation – Link Prediction in Social Networks: Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models.	
UNIT IV - VISUALIZING AND MINING IN SOCIAL NETWORKS	**(9)**
Introduction – Taxonomy of Visualizations - Structural Visualization - Semantic and Temporal Visualization - Statistical Visualization – Data Mining Methods for Social Media - Text Mining in Social Networks: Keyword Search - Query Semantics and Answer Ranking - Keyword Search over XML and Relational Data - Keyword Search over Graph Data - Classification Algorithms - Clustering Algorithms – Transfer Learning in Heterogeneous Networks.	

UNIT V - MULTIMEDIA INFORMATION NETWORKS & SOCIAL TAGGING	(9)
Multimedia Information Networks in Social Media: Introduction – Ontology based Learning – Links from Community Media – Network of Personal Photo Albums – Network of Geographical Information – Inference Methods – An Overview of Social Tagging and Applications : Introduction – Tags – Tag Generation Models – Tagging System Design – Tag Analysis – Visualization of Tags – Tag Recommendations – Applications of Tag – Tagging Problems.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Charu C. Aggarwal, "Social Network Data Analytics", 1st Edition, Springer, US, 2011
2. Peter Mika. "Social Networks and the Semantic Web", 1st Edition, Springer, New York, 2007.
3. Borko Furht. "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, US, 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3						3	3			3	3
2	3	3	3										3	
3		3	3											3
4														3
5		3	3								3		3	
CO	3	3	3						3	3	3		3	3

22CAX21 DEEP LEARNING AND ITS APPLICATIONS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				
Course Objective:	• Understand about Neural Networks architectures and how to train deep learning models efficiently. • Learn about deep unsupervised learning and mastering Deep Neural Networks.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyse optimization techniques to find the weights of the network during training.	An	20%
CO2	Apply unsupervised techniques for organizing large datasets into clusters.	Ap	20%
CO3	Equip with advanced skills in deep learning, enabling them to tackle real-time problems.	An	20%
CO4	Apply neural networks to various real-world problems in fields like image recognition, natural language processing, etc.	Ap	20%
CO5	Foster innovation for projects and explore current research trends in deep learning.	An	20%

UNIT I - NEURAL NETWORKS	**(9)**
Overview of neural networks - Loss functions – Hyperparameters - Defining Deep Learning - Common Architectural Principles of Deep Networks: Core Components - Building Blocks of Deep Networks: RBMs. Data Representation for neural networks.	
UNIT II – FEEDFORWARD NETWORKS	**(9)**
Multilayer Perception, Gradient Descent, Back Propagation, Empirical Risk Minimization, Regularization, Optimization Methods.	
UNIT III – DEEP NEURAL NETWORKS	**(9)**
Difficulty of training deep neural networks, Recurrent Neural Networks: Back Propagation through time, Long Short Term Memory, Convolutional Neural Networks: LeNet, Alex.	
UNIT IV - DEEP UNSUPERVISED LEARNING	**(9)**
Boltzman machine, Auto encoders – standard, denoising, contractive, Variational Auto encoders, Generative Adversarial Networks.	
UNIT V - APPLICATIONS	
Sentiment Analysis – Computer Vision – Image Compression – Cartoon Character Generation – Speech Recognition – Natural Language Processing.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Ian Goodfellow, YoshuaBengio and Aaron Couville, "Deep Learning", MIT Press, USA, 2016.
2. Adam Gibson and Josh Patterson, "Deep Learning A practitioner's approach", O'Reilly, USA, 2016.
3. Yusuke Sugomori, "Deep Learning: Practical Neural Networks with Java", Packet Publishing, New York, 2016.
4. Lovelyn Rose, L. Ashok Kumar, D. KarthikaRenuka, "Deep Learning using Python", Wiley India Pvt. Ltd. 2019.

Mapping of COs with POs / PSOs

Cos	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3			3											
4				3			3						3	
5									3					
6										3				
CO	3		3	3			3		3	3			3	

Professional Electives - Software Engineering and Entrepreneurship

22CAX07 MICROSERVICES AND DEVOPS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL				

Course Objective:	• Identify use cases for Microservices and Containers and key DevOps principles • Identify popular DevOps tools and Identify popular DevOps tools and Devops frameworks

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Select Microservices design and apply principles	AP	20%
CO2	Apply Microservices and DevOps	AN	25%
CO3	Understand DevOps and common tools	U	20%
CO4	Describe Develop and integrate projects using DevOps	AP	20%
CO5	Deploy and monitor projects using DevOps	AP	15%

UNIT I - INTRODUCTION TO MICROSERVICES	**(9)**
Definition of Microservices – Characteristics – Microservices and Containers – Interacting with other Services – Monitoring and Security the Services – Containerized Services – Deploying on Cloud.	
UNIT II - MICROSERVICES ARCHITECTURE	**(9)**
Monolithic architecture – Microservices architectural style – Benefits – Drawbacks of Microservices architectural style – decomposing monolithic applications into Microservices.	
UNIT III - DevOps Tools	**(9)**
History of DevOps – DevOps and Software Development Life Cycle – Waterfall Model – Agile Model – DevOps Lifecycle – DevOps Tools: Distributed Version of Control Tool Git – Automation Testing Tools – Selenium – Report Generation – Testing – User Acceptance Testing – Jenkins.	
UNIT IV - MICROSERVICES IN DEVOPS ENVIRONMENT	**(9)**
Evolution of Microservices and DevOps – Benefits of combining DevOps and Microservices – Working of DevOps and Microservices in Cloud Environment – DevOps Pipeline representation for a NodeJS based Microservices.	
UNIT V - VELOCITY AND CONTINUOUS DELIVERY	**(9)**
Velocity – Delivery Pipeline – Test Stack – Small/Unit Test – Medium/Integration Testing – System Testing – Job of Development and DevOps – Job of Test and DevOps – Job of Op and Devops – Infrastructure and the job of Ops .	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Namit Tannasseri, RahulRai, "Microservices with Azure", First Edition, Packt Publishing, UK, 2017.
2. Eberhard Wolff, "Microservices: Flexible Software Architecture", First Edition, Pearson Education, 2017.
3. James A Scott, "A Practice Guide to Microservices and Containers", MapR Data Technologies e-book.
   https://mapr.com/ebook/microservices-and-containers/assets/microservices-and-containers.pdf
4. Joyner Joseph, "Devops for Beginners", First Edition, MihailsKonoplovs Publisher, 2015.
5. Gene Kim, Kevin Behr, George Spafford, "The Phoenix Project, A Novel about IT, DevOps", Fifth Edition, IT Revolution Press, 2018.
6. Michael Huttermann, "DevOps for Developers", First Edition, APress, e-book, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2	2									2		
2		2									2		2	
3	3		2											3
4	3										2			
5		2										2		
CO	3	2	2								2	2	2	3

22CAX08 AGILE METHODOLOGY					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To build a strong knowledge about Agile Methodology • Agile software development practices and how small teams can apply them to create high-quality software.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Realize the importance of interacting with business stakeholders in determining the requirements for a software system.	U	Internal Assessment
CO2	Evaluate and select appropriate Agile processes for various project scenarios, effectively implementing them in practice.	An	20%
CO3	Analyze trade-off in selecting software engineering method for knowledge management and understanding of agile practices and knowledge management, preparing them to apply these concepts effectively in various professional settings.	An	40%
CO4	Equipped with the skills to effectively manage requirements in Agile environments and adapt to the dynamic nature of Agile projects.	Ap	20%
CO5	Implement Agile methodologies and quality assurance practices effectively in various development environments.	E	20%

UNIT I - AGILE METHODOLOGY	**(9)**
Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.	
UNIT II - AGILE PROCESSES	**(9)**
Lean Production – SCRUM – Crystal - Feature Driven Development - Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.	
UNIT III - AGILITY AND KNOWLEDGE MANAGEMENT	**(9)**
Agile Information Systems – Agile Decision Making – Earl's Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).	
UNIT IV - AGILITY AND REQUIREMENTS ENGINEERING	**(9)**
Impact of Agile Processes in RE – Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment - Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.	

UNIT V - AGILITY AND QUALITY ASSURANCE	(9)
Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Glob.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. David J. Anderson and Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.
3. Kevin C. Desouza, Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.
4. Robert C. Martin, Agile Software Development, Principles, Patterns and Practices, International Edition, Pearson Education Limited, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3			3								3	
2	1	3			2				3					3
3		1	3		3				2					3
4		3							3				3	
5	2		3						3		3	1		3
CO	3	3	3		3				3		3		3	3

22CAX09 ORGANISATIONAL BEHAVIOUR					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To determine the OB and Management concepts, personality, motivation • To evaluate Work stress and Team dynamics, Power and Leadership, Communication and Decision making				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the organization behaviour and Management concepts.	An	20%
CO2	Analyze the personality and various motivation theories.	An	20%
CO3	Realize the work stress and team work in organization.	Ap	40%
CO4	Apply the power and leadership quality in the organization.	Ap	20%
CO5	Improve the communication and decision making if the problem raised.	U	Internal Assessment

UNIT I – INTRODUCTION	**(9)**
Nature of organizations – Nature of OB – Foundations for OB – Reasons for studying OB – Shortcomings – Behavioural sciences contributed to OB – Scope – Approaches – Evolution. Management and Managers: Functions of management – Different roles played by a manager – Manager hierarchy – Evolution – Contemporary trends in management thinking.	
UNIT II – PERSONALITY AND MOTIVATION	**(9)**
Personality: Nature – Personality passes through different stages – Seven factors determine personality – Personality structure – Personality and OB. Motivation: Nature – Importance – Challenges – Theories of motivation – Motivation across cultures.	
UNIT III - WORK STRESS AND TEAM DYNAMICS	**(9)**
Work Stress: Stress experience – Work stress model – Burnout – Stress Management – Stress and performance. Team Dynamics: Nature – Benefits – Types of teams – Implementing teams in organizations – Team issues – Effective teamwork – Typical teams.	
UNIT IV - POWER AND LEADERSHIP	**(9)**
Power and Political Behaviour: Power – Power dynamics – Sources of Power – Effective use of power – Power tactics – Politics – Types – Ethics of power and politics. Leadership: Nature – Leadership and Management – Importance – Formal and informal – Leadership styles – Theories of Leadership – Issues – Development.	
UNIT V - COMMUNICATION AND DECISION MAKING	**(9)**
Communication: Significance – Interpersonal communication – Organizational communication – Networks – Roles – Policies and Audit -Informal communication – Communication media – Information technology. Decision Making: Nature – Types – Conditions – Models – Process – Styles – Individual and Group decision making.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Aswathappa K, "Organisational Behaviour", Fourteenth Edition, Himalaya Publishing House, 2022.
2. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, "Organizational Behaviour", 18 th Edition, Pearson, 2018.
3. Uma Sekaran, "Organizational Behaviour", New Delhi: Tata McGraw Hill, 2016.
4. Charles W.L Hill and Steven L McShane, "Principles of Management", McGraw Hill Education, Special Indian Edition, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2		2										
2		2		2										
3	3							2						
4					2		2							
5						3		2						
CO	3	2		2	2	3	2	2						

22CAX10 USER INTERFACE DESIGN					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To apply fundamental concepts and techniques in design of UI, to handle responsive multimedia screen layouts and do testing.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply fundamental concepts and techniques in designing user interface and get the benefits of good design	Ap	20%
CO2	Analyze the user interface design process and business functions	An	20%
CO3	Understand the types of system of windows, and navigation schemes and screen based controls	Ap	40%
CO4	Apply the multimedia for web pages, dealing problems with colors, hierarchical content	Ap	20%
CO5	Understand the organizing and layout of screen and undergo various kinds of tests.	U	Internal Assessment

UNIT I – INTRODUCTION	**(9)**
Human–Computer Interface – Graphical User Interface: Direct Manipulation Graphical System, advantages and disadvantages, Characteristics of Graphics Interface — Web User Interface: Popularity –Characteristic & Principles.	
UNIT II HUMAN COMPUTER INTERACTION	**(9)**
User Interface Design Process: Obstacles –Usability –Human Characteristics In Design – Human Interaction Speed – Business Functions: Requirement Analysis – Direct – Indirect Methods – Basic Business Functions: Design Standards – System Training and documentation needs– Human Consideration In Screen Design – Structures Of Menus – Functions Of Menus– Contents Of Menus– Formatting the Menus – Phrasing the Menu – Selecting Menu Choice – Navigating Menus– Graphical Menus.	
UNIT III WINDOWS	**(9)**
Characteristics – Components – Presentation Styles – Types– Managements– Organizations – Operations– Web Systems– Device – Based Controls: Characteristics–Screen – Based Controls: Operate Control – Text Boxes– Selection Control– Combination Control– Custom Control– Presentation Control.	
UNIT IV MULTIMEDIA	**(9)**
Text for Web Pages – Effective Feedback and Guidance and Assistance–Internationalization and Accessibility – Icons and Image: Icons – Multimedia – Colors: color uses – possible problems with colors – colors and human vision – choosing colors.	
UNIT V WINDOWS LAYOUT AND TEST	**(9)**
Organizing and laying out screens, Test, test and retest: Prototypes – Kinds of Tests – Developing and conducting the test – Analyze, Modify and Retest, Information Search – Visualization – Hypermedia – WWW– Software Tools.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Wilbent. O. Galitz ,"The Essential Guide To User Interface Design", John Wiley& Sons, 2001.
2. Ben Sheiderman, "Design The User Interface", Pearson Education, 1998.
3. Alan Cooper, "The Essential Of User Interface Design", Wiley – Dream Tech Ltd., 2002.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2		2	2										2	
3			2								2			
4			2										2	
5			2								2	2	2	
CO	2	2	2								2	2	2	

22CAX11 DESIGN THINKING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• Identify the key principles of design thinking • Use design thinking methods to empathize with users				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Understand Design Thinking Concepts and Principles	U	20%
CO2	Apply Design Thinking Methods in Every Stage of the Problem	AP	20%
CO3	Learn the Different Phases of Design Thinking	AP	20%
CO4	Apply Various Methods in Design Thinking to Different Problems	AN	20%
CO5	Learn About the Future of Design Thinking	AP	20%

UNIT I – INTRODUCTION	**(9)**
Needs of Design - Four Questions, Ten Tools - Principles of Design Thinking - The process of Design Thinking - Plan a Design Thinking Project.	
UNIT II - UNDERSTAND, OBSERVE AND DEFINE THE PROBLEM	**(9)**
Search Field Determination - Problem Clarification - Understanding of the Problem – Problem Analysis - Reformulation of the Problem - Observation Phase - Empathetic Design - Tips for Observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the Target Group - Description of Customer Needs.	
UNIT III - IDEATION AND PROTOTYPING	**(9)**
Ideate Phase - Creative Process and Creative Principles - Creativity Techniques - Evaluation of Ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and Presentation Techniques.	
UNIT IV - TESTING AND IMPLEMENTATION	**(9)**
Test Phase - Tips for Interviews - Tips for Surveys - Kano Model - Desirability Testing - Conducting workshops - Requirements for the Space - Material Requirements - Agility for Design Thinking.	
UNIT V – FUTURE	**(9)**
Design Thinking meets the Corporation – The New Social Contract – Design Activism – Designing Tomorrow.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking. [Unit 1, 2, 3, 4]
2. Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and Tim Ogilvie. [Unit 1]
3. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovaton by Tim Brown. [Unit 5]
4. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
5. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2											3	
2		2	2									2		
3				2	2									2
4	3			2										
5	3		2											
CO	3	2	2	2	2							2	3	2

22CAX12 ENTREPRENEURSHIP					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To provide the concepts of entrepreneurship, its types, scope and its challenges, process of entrepreneurial development and the steps in venture development.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Application of Entrepreneurship theories in Ventures	Ap	20%
CO2	Analyzing the social perspectives and Social Entrepreneurship regarding Legal Aspects and IPR.	An	20%
CO3	Applying of Creativity and Idea to Opportunity in Entrepreneurship.	Ap	40%
CO4	Distinguish between different plans and planning process.	An	20%
CO5	Describe the basic theories of Entrepreneurship	U	Internal Assessment

UNIT I - FUNDAMENTALS OF ENTREPRENEURSHIP	**(9)**
Introduction – Key to Development - Evolving concepts – Resource Organization – Entrepreneurial Traits – Difference Between Inventors and Entrepreneurs – Role Models – Social Support – Business Model – Entrepreneurship Mindset – Big Companies and Start-ups – Misconceptions and Myths. Entrepreneurship Developments: Types of start-ups – Intrapreneurship – Careers – Female Entrepreneurship – Small and Medium Business Enterprises – International Entrepreneurship – Role of Educational Institutions -Mistakes Startup Make – Emerging Trends.	
UNIT II - CREATIVITY AND IDEA TO OPPORTUNITY	**(9)**
Creativity: Introduction – Creativity and Entrepreneurship – Characteristics – Blocks to creativity – Creativity at work – Sources of New Ideas – Techniques for Generating Ideas – Idea to Opportunity: Definition – Recognition – Process – Sources of Opportunity – Steps for Assessing Business Potential – Steps for Tapping Opportunity.	
UNIT III - LEGAL ASPECTS AND IPR	**(9)**
Legal Aspects for Business: Introduction – Formation of Business Entity – Taxation – Deemed Public Limited Company – Requirements of Private/Public Company – Board of Directors – Roles and Responsibilities – Procedure – Legal Acts Governing Business in India – Winding up a Registered Company – Need of Lawyer – Intellectual Property Rights: University Research – IPR Importance – IP Importance for Startups – IP Rights – Patents – Trademarks – Copyrights.	
UNIT IV - BUSINESS AND MARKETING PLAN	**(9)**
Business Plan: Entrepreneurial Opportunities and Business Plan – Necessity – Drivers – Business Failures – Preparation – Prepare a Plan – Basics of Business Plan – Importance – Reasons for Failures – Marketing Plan: Marketing Research – Benefits – Scope – Types – Marketing Research on Internet – Industry Analysis – Competitor Analysis – Target Market – Market Segmentation – Market Positioning – Building a Market Plan – Marketing Mix.	

UNIT V – VENTURES	(9)
Venture Team and Organisational Plan – Venture success – Importance – Team Building – Effective Venture Team – Venture Team Development – People Management – Organisational Structure and Systems – Effective Organisational Structure – Financing Venture: Need Money – Different Stages – Sources of Finance - Seed Funding – Venture Capital Funding – Funding from Banks – Lease Financing – Launching a Venture: Steps – Incorporation and Issuance of Stocks – Stockholders Agreement – Raise Different Resources – Leverage of Intellectual Property – Build a Winning Team – Motivation and Inspiring the Team – Pilot Testing – Record Keeping of Expenses – Todo Checklist – Managing Cash – Due Diligence – Scheduling.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. S.S.Khanka, "Entrepreneurial Development", S. Chand and Company Limited, New Delhi, 2016.
2. Arya Kumar, "Entrepreneurship", Pearson Publication, 2012.
3. Dr. Robert D Hisrichis, Dr Michael P Peters, Dr Dean Shepherd, Dr Sabyasachi Sinha, "Entrepreneurship", Eleventh Edition, McGraw Hill, 2022.
4. Charantimath Poornima M, "Entrepreneurship Development and Small Business Enterprises", Pearson Education, 3rd Edition (2018).

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3									2			
3		3					3							
4								2		2				
5							3		2					
CO	3	3					3	2	2	2	2			

22CAX13 INTELLECTUAL PROPERTY RIGHTS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To understand how to protect and leverage creative and innovative assets legally and effectively**.**

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Gain a comprehensive understanding of the different types of intellectual property—such as patents, copyrights, trademarks, and trade secrets	Ap	20%
CO2	Develop familiarity with the legal frameworks, regulations, and procedures related to intellectual property both domestically and internationally.	An	20%
CO3	Learn how to apply IP laws and strategies to real-world scenarios.	An	20%
CO4	Acquire skills in managing and leveraging intellectual property for business advantage.	Ap	20%
CO5	Understand the broader ethical and social issues related to intellectual property, such as access to knowledge, innovation equity, and the balance between IP protection and public interest.	Ap	20%

UNIT I – OVERVIEW OF THE IPR REGIME	**(9)**
Introduction – Types of Intellectual Property: Industrial Property, Artistic and Literary Property, Sui Generis Systems. Need for Intellectual Property Rights – Rationale for protection of IPR – Impact of IPR on development, health, agriculture and genetic resources – IPR in India – Genesis and Development – IPR in abroad – Examples of IPR – International Organizations, agencies and treaties.	
UNIT II – PATENTS TRIPS	**(9)**
Definition – Kind of inventions protected by patent – Patentable and Non Patentable inventions, Process and product patent, double patent – patent of addition. Legal requirements for patents – Granting of patent – Rights of a patent-exclusive right. Patent application Process: Searching a Patent – Drafting of a Patent – Filing of a patent – Types of Patent Applications – Patent Document: Specification and Claims – Management of IP Assets and IP Portfolio – Commercial exploitation of IP – Assignment, Licensing, Infringement. Different Layers of International Patent System: National, Regional and International Options.	
UNIT III – TRADEMARKS	**(9)**
Rights of Trademark – Kind of Signs used as trademarks – Types, Purpose and Functions of a Trademark - Trademark Protection – Trademark Registration – Acquisition of Trademark Rights – Protectable matter – Selecting and Evaluating Trademark – Trademark Registration Processes.	
UNIT IV – COPYRIGHTS	**(9)**
Rights and Protection covered by Copyright – Law of Copyrights: Fundamental of Copyright Law – Originality of Material - Rights of reproduction – Rights to perform the work publicly, Copyright Ownership issues – Obtaining Copyright Registration – Notice of Copyright – International Copyright Law – Infringement of Copyright under Copyright Act. Related Rights: Distinction between related Rights and Copyright – Celebrity Rights, Academic Integrity or Plagiarism: An Intellectual Theft.	

UNIT V – GEOGRAPHICAL INDICATION OF GOODS AND INDUSTRIAL DESIGN	(9)
Geographical indication of goods: Types - Need of GI Protection and GI Laws – Indian GI Act. Traditional Knowledge: Indigenous – Medicinal – Bio-Prospecting Knowledge examples – Need for Protection – Positive Protection – Defensive Protection – Legal Aspects. Industrial Designs: Protection – Kind of Protection provided by Industrial Designs – Integrated Circuits. Role and Liabilities of IPRs in India: Cyberlaw issues – Criminal Law, Data Safety, Online Privacy, Health Privacy – Freedom of Expression and Human Rights, Net Neutrality – National Security.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. K. Bansal & P. Bansal, "Fundamentals of IP for Engineers".
2. Deborah, E. Bouchoux, "Intellectual Property Right", Cengage Learning.
3. Prabuddha Ganguli, "Intellectual Property Right – Unleashing the Knowledge Economy", Tata McGraw Hill Publishing Company Ltd.
4. Electronic Resource Guide ERG Published online by the American Society of International Law.
5. "Intellectual Property Rights and Development Policy: Report of the Commission on Intellectual Property Rights", London September 2002 (Web Resource).
6. WIPO Intellectual Property Handbook: Policy, Law and Use (Web Resource)

Mapping of COs with POs / PSOs

Cos	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3					3							
3		3					3							
4		3					3							
5		3					3							
CO	3	3					3							

22CAX14 HUMAN RESOURCE MANAGEMENT				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• Identify HRM functions (recruitment, selection, training, compensation, appraisal) • Identify training methods (on-the-job, off-the-job, e-learning) and types of compensation (salary, benefits, incentives)

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Gain knowledge on various aspects of HRM	Ap	20%
CO2	Gain knowledge needed for success as a human resources professional	U	20%
CO3	Develop skills needed for a successful HR manager	Ap	20%
CO4	Prepare to implement concepts learned in the workplace	An	20%
CO5	Awareness of emerging concepts in HRM	Ap	20%

UNIT I PERSPECTIVES IN HUMAN RESOURCE MANAGEMENT	**(9)**
Evolution of human resource management – The importance of the human capital – Role of human resource manager – Challenges for human resource managers - trends in Human resource policies – Computer applications in human resource management – Human resource accounting and audit.	
UNIT II HUMAN RESOURCE PLANNING AND RECRUITMENT	**(9)**
Importance of Human Resource Planning – Forecasting human resource requirement –matching supply and demand - Internal and External sources- Organizational Attraction-. Recruitment, Selection, Induction and Socialization- Theories, Methods and Process.	
UNIT III TRAINING AND DEVELOPMENT	**(9)**
Types of training methods –purpose- benefits- resistance. Executive development program – Common practices - Benefits – Self-development – Knowledge management.	
UNIT IV EMPLOYEE ENGAGEMENT	**(9)**
Compensation plan – Reward – Motivation – Application of theories of motivation – Career management – Mentoring - Development of mentor – Protégé relationships- Job Satisfaction, Employee Engagement, Organizational Citizenship Behavior: Theories, Models.	
UNIT V PERFORMANCE EVALUATION AND CONTROL	**(9)**
Method of performance evaluation – Feedback – Industry practices. Promotion, Demotion, Transfer and Separation – Implication of job change. The control process – Importance – Methods – Requirement of effective control systems grievances – Causes – Implications – Redressal methods.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14th Edition, Pearson Education Limited, 2015.
2. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley International Student Edition, 11th Edition, 2014.
3. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012.
4. Bernadin, Human Resource Management ,Tata Mcgraw Hill ,8th edition 2012.
5. Wayne Cascio, Managing Human Resource, McGraw Hill, 2015.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2											3	
2		2	2									2		
3				3	3									2
4	3			3										
5	3		2											
CO	3	2	2	3	3							2	3	2

22CAX22 FULL STACK FRAMEWORK				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• Prepare students as full stack developers. • Equip with the skills and knowledge needed to build modern web applications. • Use frontend to backend, manage databases, deploy applications, and collaborate effectively.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	To explain the basics needed for web application development.	Ap	20%
CO2	To apply frontend and backend technologies with a flexible database solution.	Ap	20%
CO3	To empower with the skills and tools necessary to build scalable, modern web applications efficiently.	An	20%
CO4	To design reusable UI components and server-side programming efficiently.	Ap	20%
CO5	To create dynamic and feature-rich applications to meet the demands.	C	20%

UNIT I - BASICS OF MERN STACK	**(9)**
MERN Introduction-MERN Components - React - Node.js - Express - MongoDB - Need for MERN - Server-Less Hello World - Server Setup - nvm - Node.js npm.	
UNIT II - BOOTSTRAP AND MONGODB	**(9)**
Introduction to Bootstrap - Bootstrap Basics - Bootstrap Grids - Bootstrap Themes - Bootstrap CSS - Bootstrap JS. MongoDB - MongoDB Basics - Documents -Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB.	
UNIT III – ANGULAR JS	**(9)**
Angular JS Introduction - Creating Reusable Components with Directives - Data Handling - Dependency Injection and Services – Scope – Modules - Jasmine testing framework - Automating the Workflow.	
UNIT IV - NODE JS and EXPRESS JS	**(9)**
Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js Event Emitter - Node.js Data Access - Express REST APIs - REST - Resource Based - HTTP Methods as Actions - JSON- Express - Routing - Handler Function – Middleware-Rest API.	
UNIT V – jQuery	**(9)**
Introduction to jQuery - jQuery Syntax - jQuery Selectors - jQuery Events - jQuery Effects - jQuery HTML - jQuery Traversing - jQuery AJAX & Misc.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, A Press Publisher, 2019.
2. Bradshaw, S., Brazil, E., & Chodorow, K. (2019). MongoDB: the definitive guide: powerful and scalable data storage. O'Reilly Media.
3. Rodrigo Branas, "Angular Js Essentials", Packet Publishing Ltd, 2014.
4. Mardan, A. (2014). Express. js Guide: The Comprehensive Book on Express. js. Azat Mardan.
5. Kogent Learning Solutions Inc. "HTML5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQUERY", Wiley India Pvt. Limited, 2011.
6. Deitel and Deitel and Nieto, "Internet and World Wide Web – How to Program", Prentice Hall, 5th Edition, 2011.
7. Zammetti, F. (2020). Modern Full-Stack Development: Using TypeScript, React, Node. js, Webpack, and Docker. Apress.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3	3												
3		3	3								3		3	3
4		3	3								3		3	3
5		3	3								3		3	3
CO	**3**	**3**	**3**								**3**		**3**	**3**

22CAX23 - DIGITAIL MARKETING				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives:	To provides basics of digital marketing, its underlying technologies and frameworks, consumer behavior aspects including demand management and Integrated Marketing Communications for digital platform

Course Outcomes: The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Explain the basic concepts of digital marketing and apply to solve the real world problems	Ap	20%
CO2	Carry out the various digital marketing strategies	Ap	20%
CO3	Explore digital marketing operation setup and apply for web development	Ap	20%
CO4	Make use of the digital marketing campaign management	Ap	20%
CO5	Determine the emerging areas of digital marketing	Ap	20%

UNIT I - BASICS OF DIGITAL MARKETING	**(9)**
Evolution of Digital Marketing – Digital Marketing an Introduction – Internet Marketing: Underlying Technology and Frameworks – Digital Marketing Framework – Factors Impacting Digital Marketplace – Value Chain Digitization – The Consumer for Digital Marketing – Consumer Behavior on the Internet – Evolution of Consumer Behavior Models – Managing Consumer Demand – Integrated Marketing Communications.	
UNIT II - DIGITAL MARKETING STRATEGY DEVELOPMENT	**(9)**
Digital Marketing Assessment Phase: Elements of the Assessment Phase – Digital Marketing Internal Assessment – Digital Marketing Objectives Planning – Digital Marketing Strategy Definition: Digital Marketing Strategy Groundwork – Defining the Digital Marketing Mix – Digital Marketing Strategy Roadmap.	
UNIT III – DIGITAL MARKETING PLANNING AND SETUP	**(9)**
Digital Marketing Communications and Channel Mix: Digital Marketing Planning Development – Designing the Communication Mix – Introduction to Digital Marketing Channels. Digital Marketing Operations Setup: Understanding Digital Marketing Conversion – Basics of Web Development and Management – User Experience, Usability, and Service Quality Elements.	
UNIT IV - DIGITAL MARKETING EXECUTION	**(9)**
Digital Marketing Campaign Management: Basic Elements of Digital Campaigns – Basic Elements of Digital Campaign Management – Implementing Intent – Based Campaigns (Search Execution) – Implementing Brand – Based Campaigns (Display Execution) – Campaign Execution for Emerging Marketing Models – Campaign Analytics and Marketing RoI. Digital Marketing.	

UNIT V - DIGITAL BUSINESS PRESENT AND FUTURE	(9)
Digital Marketing – Landscape and Emerging Areas: Digital Marketing – Global Landscape – Digital Marketing – The Indian View – Digital Marketing – Emerging Trends and Concepts. A Career in Digital Marketing: Emerging Opportunities for Digital Marketing Professionals – Building a Career in Digital Marketing – Top Digital Marketing Areas as Career Tracks – Approaching a Career in Digital Marketing.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Puneet Bhatia, "Fundamentals of Digital Marketing", 1st Edition, Pearson Education, 2019.
2. R S N Pillai, Bagavathi, "Modern marketing Priinciples and Practices",2nd Edition, 2020
3. Dominik Kosorin, "Introduction to Programmatic Advertising", 1 st Edition, 2017.

Mapping of COs with POs / PSOs

COs	PO												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2											2	
2	3	2												
3	3	2												
4	3	2											2	
5	2	2												
CO	3	2											2	

Professional Electives: Digital Security

22CAX15 ETHICAL HACKING				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL				
Course Objective:	• Learn ethical hacking tools and techniques and understand system vulnerabilities and weaknesses. • Identify data protection methods (backup, redundancy) and web application attack techniques			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Realize the basics of Hacking	Ap	20%
CO2	Explain basic vulnerabilities in any computing system	U	20%
CO3	Categorize types of hacking attacks	An	20%
CO4	Interpret vulnerabilities in Wireless and Firewall systems	An	20%
CO5	Determine possible attacks in complex real-time systems and countermeasures	Ap	20%

UNIT I – INTRODUCTION	**(9)**
Introduction: Hacking – types of hacking - purpose – types of hackers – Ethical hacking process - Hacking terminologies – tools – skills.	
UNIT II – CASING THE ESTABLISHMENT	**(9)**
Foot Printing: Definition - Internet foot printing – Scanning – Determine System is Alive – Determine Services Running or Listening – Detecting the Operating System – Processing and storing scan data – Enumeration – basic banner grabbing – Enumerating common Network services.	
UNIT III – PASSWORD HACKING	**(9)**
Introduction – Password Cracking – Cracking the Windows – Glide Code – Windows Screen Saver Password – XOR – Internet Connection Password – HTTP authentication – BIOS Passwords – Cracking other passwords – Remote Access Sharing Password Decoding – Breaking DES algorithm – Brute Force Password Cracking – Default Passwords.	
UNIT IV - WIRELESS AND FIREWALL HACKING	**(9)**
Wireless Equipment – Discovery and monitoring – Denial of Service Attacks – Common DoS Attack Techniques – DoS Countermeasures – Encryption Attacks – Authentication attacks – Firewalls – Firewalls landscape – Firewall identification – Scanning through firewalls – Packet filtering – Case Studies.	

UNIT V - APPLICATION HACKING AND COUNTER MEASURES	(9)
Web and Database Hacking – Web Server Hacking – Web application Hacking – Common Web application Vulnerabilities – Database Hacking – Mobile Hacking – Hacking android iOS.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Ankit Fadia, "An Unofficial Guide to Ethical Hacking", Macmillan India Ltd, 2006.
2. EC – Council Press, "Ethical Hacking and Countermeasures: Attack Phases", 1st Edition, Cengage Learning, 2009.
3. Bob Bittex, "Hacking for Beginners: Ultimate Guide to become a Hacker", Paperback Edition, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3												
2		3									2			
3		3										2	2	
4	3						2							2
5									2		2			
CO	3	3					2		2		2	2	2	2

22CAX16 DIGITAL FORENSICS				
	L	T	P	C
	3	0	0	3

PREREQUISITE : 22CAB12

Course Objective:	• Digital forensics is the process of collecting, analyzing, and preserving digital evidence to investigate cybercrimes, security incidents, or data breaches. • To understand the inner workings of Windows and Linux systems, digital forensics, regarding the tradeoffs and differences between various forensic tools

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Discuss rules, laws, policies, and procedures that affect digital forensics	AP	20%
CO2	Explain the important file meta data and apply their use in a forensic investigation.	U	20%
CO3	Apply file metadata in forensic investigation	AP	20%
CO4	Demonstrate use of digital forensics tools	AN	20%
CO5	Analyze digital investigation from initial recognition, evidence gathering, preservation and analysis and the completion of legal proceedings	AN	20%

UNIT I - DIGITAL FORENSICS	**(9)**
Digital forensics and investigations as a profession - Understanding Digital forensics - Digital forensics versus other related disciplines, A brief History of Digital Forensics - Understanding case laws - Developing digital forensics resources - Preparing for digital investigations - Understanding law enforcement agency investigations - Following the legal process - Understanding corporate investigations - Establishing company policies - Displaying warning Banners.	
UNIT II - WINDOWS SYSTEMS AND ARTIFACTS	**(9)**
Windows Systems and Artifacts: Introduction - Windows File Systems - File Allocation Table - New Technology File System - File System Summary – Registry - Event Logs - Prefetch Files - Shortcut Files - Windows Executables.	
UNIT III - LINUX SYSTEMS AND ARTIFACTS	**(9)**
Linux Systems and Artifacts: Introduction - Linux File Systems - File System Layer - File Name Layer - Metadata Layer - Data Unit Layer - Journal Tools - Deleted Data - Linux Logical Volume Manager - Linux Boot Process and Services - System V – BSD - Linux System Organization and Artifacts – Partitioning - File system Hierarchy - Ownership and Permissions - File Attributes - Hidden Files - User Accounts - Home Directories - Shell History GNOME Windows Manager Artifacts – Logs - User Activity Logs – Syslog - Command Line Log Processing - Scheduling Tasks.	
UNIT IV - CURRENT DIGITAL FORENSICS TOOLS	**(9)**
Evaluating Digital Forensics Tool Needs: Types of Digital Forensics Tools - Tasks Performed by Digital Forensics Tools - Tool Comparisons - Other Considerations for Tools. Digital Forensics Software Tools: Command-Line Forensics Tools - Linux Forensics Tools - Other GUI Forensics Tools. Digital Forensics Hardware Tools: Forensic Workstations - Using a Write-Blocker.	

UNIT V - DIGITAL FORENSICS ANALYSIS AND VALIDATION	(9)
Determining data to collect and analyze: Approaching digital Forensics cases – Using Autopsy to Validate data – collecting hash Values in Autopsy - Validating Forensic Data - Validating with Hexadecimal Editors – validating with Digital Forensics tools - Addressing Data – Hiding Techniques: Hiding files by using the OS – Hiding partitions - Marking bad Clusters – Bit shifting – Understanding steganalysis methods – Examining Encrypted files – Recovering passwords.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Cory Altheide, Harlan Carvey, "Digital Forensics with Open Source Tools", Syngress imprint of Elsevier, 2011.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", Sixth Edition, 2018.
3. Angus M.Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3	3											3	
3		3	3											3
4				3									3	
5							3							
CO	3	3	3	3			3						3	3

22CAX17 VIRTUALIZATION AND CLOUD SECURITY					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 22CAB04					
Course Objective:	• Identify virtualization technologies and cloud computing benefits and challenges. • Cloud computing architecture patterns, cloud security controls and measures.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Explain benefits, attacks, and challenges of virtualization	U	20%
CO2	Describe characteristics, services, threats, and security of cloud	U	20%
CO3	Explain various models and issues in cloud	An	20%
CO4	Explain availability of management in cloud security	Ap	20%
CO5	Describe various compliances and auditing cloud for compliance	Ap	20%

UNIT I – VIRTUALIZATION	**(9)**
Impact and business benefits of Virtualization. Risks of Virtualization include attacks on Virtualization infrastructure, Hyper jacking and Virtual Machine jumping. Hyper jacking attacks like Blue Pill, Sub Virt, Vitriol, attacks on Virtualization features and compliance and Management challenges. Strategies and counter measures for addressing Virtualization risks	
UNIT II - CLOUD SECURITY	**(9)**
History of Cloud Computing, characteristics of cloud computing, architecture influence, technology influence, Operational influence, Various Cloud Delivery, Trusted Cloud Initiative (TCI) and Cloud Trust Protocol (CTP). Transparency as a Service (TaaS) and Security as a Service (SecaaS), Top Threats to Cloud Security, Cloud Security Services: Authentication, Authorization, Auditing & Accountability (AAAA), NIST 33 Security Principles, Secure Cloud Software Testing: Testing for Security Quality Assurance & Cloud Penetration Testing.	
UNIT III - CLOUD COMPUTING ARCHITECTURE	**(9)**
Cloud delivery models, Cloud deployment models, Architectural consideration, Identity management and access control, Autonomic security, Governance and Enterprise Risk in the Cloud. Legal and Electronic Discovery in the Cloud. Compliance and Audit issues in the Cloud. Portability and Interoperability issues in the Cloud. Traditional Security, Business Continuity Management and Disaster Recovery in the Cloud.	
UNIT IV - CLOUD SECURITY MANAGEMENT	**(9)**
Security management standards, Security management in the Cloud, Availability management: SaaS availability management, PaaS availability management, IaaS availability management. Access control, Security vulnerability, Patch and configuration management. Encryption and Key Management in the Cloud, Identity and Access Management in the Cloud, relevant IAM standers and protocols for cloud services.	

UNIT V - AUDIT AND COMPLIANCE	(9)
Key privacy concern in cloud, Changes to privacy risk management and compliance in relation to cloud computing, Legal and regulatory implication, Internal policy compliance, Governance, Risk and Compliance (GRC), Control objective of cloud computing, control consideration for cloud service provider users, Regulatory or external compliance, cloud security Alliance, Auditing cloud for compliance.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Dave Shackleford, "Virtualization Security: Protecting Virtualized Environments", 2013 (Paperback). (Unit – I).
2. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Security", First Edition. (Paperback). (Unit – II, Unit – III)
3. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", First Edition (Paperback). (Unit – IV, Unit - V)
4. Melvin B. Greer Jr., Kevin L. Jackson, "Practical Cloud Security: A Cross-Industry View", CRC Press, First Edition (2 August 2016). (Paperback)

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3												
2		3									2			
3		3										2	2	
4	3						2							
5									2		2			
CO	3	3					2		2		2	2	2	

22CAX18 BLOCKCHAIN TECHNOLOGY					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• Identify blockchain applications and use cases, crypto currency wallets and transactions. • Identify Ethereum code execution and hyper ledger use cases and applications.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Identify basics of blockchain technology concepts and applications	Ap	20%
CO2	Discover implementation of crypto currency	An	20%
CO3	Relate deep understanding of Ethereum model, consensus model, and code execution	An	20%
CO4	Illustrate architectural components of hyper ledger and development framework	Ap	20%
CO5	Infer alternative blockchain and emerging trends in blockchain	Ap	20%

UNIT I - BLOCKCHAIN ESSENTIALS	**(9)**
History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.	
UNIT II – CRYPTOCURRENCY	**(9)**
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.	
UNIT III – ETHEREUM	**(9)**
Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.	
UNIT IV - WEB3 AND HYPERLEDGER	**(9)**
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.	
UNIT V - ALTERNATIVE BLOCKCHAIN AND EMERGING TRENDS	**(9)**
Kadena – Ripple – Rootstock – Quorum – MaidSafe – BigchainDB - Tendermint – Scalability – Privacy – Blockchain Research – Notable Projects – Miscellaneous Tools.	
	TOTAL (L:45) : 45 PERIODS

REFERENCES:

1. Imran Bashir, "Mastering Blockchain", 2ndEdition, Packt Publication, Mumbai, 2018.
2. Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT Publisher, 2017.
3. Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", 1stEdition, O"Reilly Media Inc, USA,2015.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3												
2		3									2			
3		3										2	2	
4	3						2							2
5									2		2			
CO	3	3					2		2		2	2	2	2

22CAX19 SOFTWARE QUALITY ASSURANCE				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To illustrate knowledge about software testing process flow and testing documents. • To equip the management concepts and testing techniques using tools.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Solve with comprehensive knowledge in software testing and skills in quality and software quality management to enhance software development project outcomes.	U	Internal Assessment
CO2	Analyze software testing knowledge to effectively contribute to software quality assurance.	An	20%
CO3	Design the test cases and to getting familiarity over major testing team process with essential skills in configuration management, risk management, and testing processes.	An	40%
CO4	Evaluate practical experience in using Silk Test tool for automated functional testing.	Ap	20%
CO5	Test practical skills in independent study as a member of a team for planning, executing, and managing testing activities of test management tool.	E	20%

UNIT I – INTRODUCTION TO QUALITY AND SOFTWARE QUALITY	**(9)**
Introduction – Software Development Life Cycle (SDLC) – Historical Perspective of Quality – Total Quality Management – Continuous Improvement Cycle – Constraints of Software Quality Assessment – Customer is a King – Software Quality Management – Software Defects – Important Aspects of Quality Management – Types of Products – Quality Management System Structure – Pillars of Quality Management System	
UNIT II – FUNDAMENTALS OF SOFTWARE TESTING	**(9)**
Definition of Testing – Approaches to Testing – Popular Definitions of Testing – Testing during Development Life Cycle – Requirements Traceability Matrix - Essentials of Software Testing – Workbench – Important Features of Testing Process – Test Planning – Test Team Approach – Testing Process – Black Box Testing – White Box Testing	
UNIT III - MANAGEMENT CONCEPTS AND TESTING TECHNIQUES	**(9)**
Configuration Management – Configurable Items – Base Lining –Configuration Management Planning – Types of Software Risks – Handling of Risks in Testing – Unit Testing – Integration Testing – System Testing –User Acceptance Testing – SRS – Use Case Design – Test Case Design – Bug Report Preparation – Case Studies.	
UNIT IV - FUNCTIONALITY TOOL	**(9)**
Silk Test : Introduction – Architecture – Automated Testing Process – Quick start with Silk Test – Configuring the settings - Exposure to Silk Test IDE – Plug and Play test case.	

UNIT V - TEST MANAGEMENT	(9)
Testing Process – Specifying Testing Requirements – Planning Tests – Calling Tests with Parameters – Creating and Viewing Requirements Coverage – Generating Automated Test Scripts – Running Tests – Writing Test Sets – Case Studies.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. M.G. Limaye, Software Testing, Tata McGraw – Hill, 2009.
2. Dr.K.V.V.Prasad, Software Testing Tools, Dreamtech, 2004.
3. URL : www.onestoptesting.com/SilkTest
4. URL : www.onestoptesting.com/testdirector

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3			3								3	
2	1	3			2				3				3	
3		1	3		3				2					3
4		3							3					
5	1		3						3		3			3
CO	3	3	3		3				3		3		3	3

22CAX20 INFORMATION SECURITY				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• Identify types of threats and vulnerabilities and Identify security goals and objectives • Use risk mitigation and control strategies and Evaluate security policies and procedures

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Recognize the need of information security	Ap	20%
CO2	Explore laws and ethics in information security	An	20%
CO3	Identify, control, and manage risk	Ap	20%
CO4	Explore technologies such as firewall, Honeypots, etc., used for security	U	20%
CO5	Handle Security Certification and Accreditation	An	20%

UNIT I – INFORMATION SECURITY AND THE NEED FOR SECURITY	**(9)**
History of Information Security – Security - CNSS Security Model-Components of an Information System – Security in the System Life Cycle – Security Professionals and the Organization – Communities of Interest – Information Security: Threat and Attacks – Compromises to Intellectual Property – Deviations in Quality of Service-Espionage – Force of Nature – Human Error – Information Extortion – Sabotage-Software Attacks – Technical Hardware Failures – Technical Software Failures.	
UNIT II - ISSUES IN INFORMATION SECURITY AND PLANNING FOR SECURITY	**(9)**
Law and ethics in information Security – Relevant U.S. Laws-International Laws and Legal Bodies – Ethics and Information Security – Codes of Ethics of Professional Organizations – Key U.S. Federal Agencies – Planning for Security: Information Security Policy, Standards, and Practices – The Information security Blueprint – Security Education, Training, and Awareness Program.	
UNIT III - RISK MANAGEMENT	**(9)**
Overview - Risk Identification - Risk Assessment - Risk Control - Quantitative Versus Qualitative Risk Management Practices - Recommended Risk Control Practices.	
UNIT IV - SECURITY TECHNOLOGY	**(9)**
Access Control – Firewalls - Protecting Remote Connections – Intrusion Detection and Prevention Systems – Honeypots, Honeynets, and Padded Cell Systems – Scanning and Analysis Tools.	

UNIT V - IMPLEMENTING SECURITY IN INFORMATION AND PERSONNEL	(9)
Information Security Project Management – Technical Aspects of Implementation-Non-technical Aspects of Implementation - information Systems Security Certification and Accreditation - Credentials for Information Security Professionals - Employment Policies and Practices - Security Considerations for Temporary Employees, Consultants, and Other Workers - Internal Control Strategies – Privacy and Security of Personnel Data.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", 6th Edition, Cengage Learning, India, 2018.
2. Charles P. Pfleeger and Shari Lawrence Pfleeger, "Security in Computing", 5th Edition, Prentice Hall, 2018.
3. Micki Krause, Harold F. Tipton, "Handbook of Information Security Management", Vol. 6, 6th Edition, CRC Press, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3											3	
2		3	2									2		
3			2											2
4	3											2		
5	3		2											
CO	3	3	2									2	3	2

Open Elective Courses

22CAO01 EMPLOYABILITY ENHANCEMENT AND ANALYTICAL SKILLS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE : NIL				
Course Objective:	• To enable learners to achieve linguistic competence in oral and written discourse efficiently • To enhance analytical, mathematical, and critical thinking skills for solving quantitative problems and logical puzzles efficiently.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Develop a foundation in grammar that supports lifelong learning, enabling them to continue improving their language skills.	U	20%
CO2	Develop various listening strategies and resources for continuing to improve their listening and speaking skills independently.	U	20%
CO3	Demonstrate the ability to comprehend and to write coherently and fluently across different genres and purposes.	Ap	20%
CO4	Exhibit sound knowledge to solve problems of quantitative aptitude.	Ap	20%
CO5	Draw valid conclusions, identify patterns, and solve problems.	Ap	20%

UNIT I – GRAMMAR	**(9)**
Parts of Speech – Synonyms & Antonyms - Primary Auxiliary Verbs – Modal Auxiliary Verbs - Tenses – Articles– Preposition – Conjunction–Common Errors - Subject Verb Agreement – Error Spotting – One word Substitution – Jumbled Sentences – Confusable word – Idioms and Phrases – Degrees of Comparison – Sentence Completion.	
UNIT II - LISTENING AND SPEAKING	**(9)**
LISTENING - Listening Strategies - Listening for Specific Information- Listening to TED & INK Talks - Listening for Signpost Language - Listening to Telephonic Conversations. SPEAKING - Group/Pair Presentations - Visume - Interview Skills – GD.	
UNIT III - READING AND WRITING	**(9)**
READING - Strategies for Effective Reading - Reading for Specific Information - Speed Reading Techniques - Critical Reading. WRITING - Job Application Letter with Resume - E-mail Writing - Paragraph Writing.	
UNIT IV – APTITUDE	**(9)**
Number System- Ratio & Proportion-Percentages-Averages-Profit & Loss.	
UNIT V – REASONING	**(9)**
Figure Series-Blood Relation-Analogy-Coding and Decoding-Odd one out.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Tickoo, M. L., A. E. & Subramaniam, P. R., "Intermediate Grammar Usage & Composition", Orient Blackswan, 1976.
2. Davis, Jason and Liss, Rhonda, "Effective Academic Writing (Level 3)", Oxford University Press, 2006.
3. Koneru, Aruna, "English Language Skills" Tata McGraw-Hill Education, 2011.
4. Raman, Meenakshi and Sharma, Sangeeta, "Technical Communication English Skills for Engineers", Oxford University Press, 2008.
5. Khattar, Dinesh, "Quantitative Aptitude", Third Edition New Delhi: Pearson, 2014.
6. Aggarwal R.S., "A Modern Approach to Verbal & Non Verbal Reasoning", Revised Edition, S. Chand Publishers, New Delhi, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1					2	3								
2					2	3								
3					2	3								
4		2		2										
5		2		2										
CO		1		1	2	3								

BRIDGE COURSES

22CAW01 FUNDAMENTALS OF COMPUTERS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To understand the fundamental concepts of computer hardware, software, and programming. • To apply problem-solving techniques and programming skills using C language.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Explain the basic fundamentals of computer hardware and software.	An	20%
CO2	Apply problem-solving techniques using algorithms, flowcharts, and pseudo code.	Ap	40%
CO3	Analyze and implement branching, looping, and array concepts in C programming.	An	20%
CO4	Design and develop C programs using functions, structures, and arrays.	Ap	20%
CO5	Implement office automation techniques using MS Office tools.	C	Internal Assessment

UNIT I - INTRODUCTION TO COMPUTER SOFTWARE AND HARDWARE	**(9)**
Computer System - Programming Languages – Hardware and Software – Types of Computer – Generations of Computer - Computer Applications – Data Processing – Computer Networking – Electronic Commerce – Computer Security – Threat – Virus.	
UNIT II - PROBLEM SOLVING TECHNIQUES AND BASIC STRUCTURE OF C	**(9)**
Representation of Algorithm, Flowchart, Pseudo code with examples, From algorithms to programs, source code. Overview of C: Basic structure of C program, executing a C program. Constant, variable and data types, Operators and expressions.	
UNIT III - BRANCHING, LOOPING AND ARRAY	**(9)**
Conditional statement: If, If..else, Nested if…Branching: break , continue , return , and goto. Looping: While, Do..while, For Loop. Arrays: One Dimensional Array - Two Dimensional Arrays - Strings and Array of Strings.	
UNIT IV - FUNCTIONS AND STRUCTURES	**(9)**
Function General Format - Function Arguments: Pass by Value, Pass by Reference, Calling Functions with Arrays - Arguments to Main Function - Return Statement – Recursion. Structures - Nested Structures - Array of Structures - Passing Structures to Functions - Arrays and Structures with in Structures.	

UNIT V - OFFICE AUTOMATION	(9)
Word – Spread Sheet – Database – Slide Presentation.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Herbert Schildt, "C: The Complete Reference", Fourth Edition, McGraw Hill, 2017.
2. Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.
3. Kernighan B.W. and Ritchie D.M., "The C Programming Language", Second Edition, Pearson Education, 2008.
4. Dr. S. S. Shrivastava, "MS Office", Firewall Media, 2008.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3		3									3	
2	3			3					3				3	3
3			3						3	3	3	3	3	3 2
4			3		3					3	3	3		
5		3	3		3	3				3			3	3
CO	3	3	3	3	3	3			3	3	3	3	3	3

22CAW02 MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To explore matrices for solving linear systems and transformations, while set theory focuses on understanding sets, their relationships, and operations. • To examine the principles of formal logic, the structure of formal languages and the design and analysis of finite state automata.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of matrices with the concepts of eigen values to study their problems in data science.	Ap	20%
CO2	Examine the concepts of sets, relation and functions for designing and solving problems.	An	20%
CO3	Apply logical operations and predicate calculus to solve problems in Artificial Intelligence.	Ap	20%
CO4	Analyze the regular expressions, context-free grammars for specific languages in complier design and automata theory.	An	20%
CO5	Determine the logical concepts in engineering design using effective mathematical tool.	An	20%

UNIT I – MATRICES	**(9)**
Characteristics Equations – Properties - Eigen Values and Eigen Vectors - Cayley Hamilton Theorem.	
UNIT II - BASIC SET THEORY	**(9)**
Basic Definitions - Venn Diagrams and Set Operations - Principle of Inclusion and Exclusion - Permutations and Combinations.	
UNIT III – LOGIC	**(9)**
Propositional logic – Logical Connectives – Truth Tables – Normal Forms (Conjunctive and Disjunctive) – Predicate Logic – Universal and Existential Quantifiers – Proof Techniques – Direct and Indirect Method – Proof by Contradiction – Mathematical Induction.	
UNIT IV - FORMAL LANGUAGES	**(9)**
Languages and Grammars - Phrase Structure Grammar - Classification of Grammars - Pumping Lemma for Regular Languages.	
UNIT V - FINITE STATE AUTOMATA	**(9)**
Finite State Automata - Deterministic Finite State Automata (DFA), Non-Deterministic Finite State Automata (NFA) - Equivalence of DFA and NFA - Equivalence of NFA and Regular Languages.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Kenneth H.Rosen, "Discrete Mathematics and Its Applications", Tata McGraw Hill, Eighth Edition, 2016.
2. Hopcroft and Ullman, "Introduction to Automata Theory, Languages and Computation", Narosa Publishing House, Delhi, 2015.
3. A. Tamilarasi & A. M. Natarajan, "Discrete Mathematics and its Application", Second Edition, Khanna Publishers, 2005.
4. M. K. Venkataraman, "Engineering Mathematics", Volume II, Second Edition, National Publishing Company, 1989.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		2												
3	3													2
4		2												2
5		2			2				2					2
CO	**3**	**2**			**2**				**2**					**2**

22CAW03 OBJECT ORIENTED PROGRAMMING USING C++					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objective:	• To build a strong knowledge about C++ in Object Oriented Programming. • To apply the basic concepts in coding to solve a problems.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Build a strong foundation in C++ and OOP, preparing students to develop more complex software applications and enhancing their problem-solving capabilities.	U	Internal Assessment
CO2	Acquire skills in file handling, including reading from and writing to files. Enhance problem-solving skills by integrating arrays, functions, and file operations in comprehensive C++ programs.	An	20%
CO3	Develop a solid understanding of the fundamental concepts of object-oriented programming in C++, specifically focusing on objects and using classes, and understanding the lifecycle of objects through constructors and destructors.	An	40%
CO4	Apply the types of inheritance concept in C++ code and be able to effectively use it to design and implement complex software systems.	Ap	20%
CO5	Problem solving skills and practical applications to solve problems in a more intuitive and maintainable way.	E	20%

UNIT I - OVERVIEW OF C++	**(9)**
History of C++ – OOPs Concept – Procedural VS OOP Programming – Keywords - Data Types – Constants – Variables- Operators – Expressions. Control Flow Statements.	
UNIT II - ARRAYS , FUNCTIONS AND FILES	**(9)**
Array- one dimensional of array–two dimensional array - Functions - Declaration of Functions – Files and its Operations.	
UNIT III - OBJECT, CLASS AND CONSTRUCTOR	**(9)**
Create object, Create class, Declaration of class, Scope of class, nested class, Inner Class. Constructor- Introduction of Constructor – Types of Constructor – Destructor.	
UNIT IV – INHERITANCE	**(9)**
Inheritance – Inheritance Types: Single Inheritance, Multiple Inheritance, Multi level Inheritance, Hybrid Inheritance, Hierarchical Inheritance.	
UNIT V – POLYMORPHISM	**(9)**
Polymorphism – Function overloading-Function overriding – operator overloading.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. E. Balagurusamy, "Object Oriented Programming with C++", Eighth Edition, 2021.
2. Herbert Schildt , "C++ : The Complete Reference", Fourth Edition, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1		3						2				3	
2		3	1		2									3
3	2	1		3							3			2
4		3		1							2		3	
5	3		2		3				3				3	
CO	3	3	3	3	3				3		3		3	3

22CAW04 COMPUTER ORGANIZATION				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• Identify digital electronics applications and Identify computer hardware components • Determine addressing modes and Learn about processor design and memory types

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Design digital circuits by simplifying Boolean functions	Ap	20%
CO2	Investigating organization and working principle of computer	An	20%
CO3	Apply concept of logic units and instructions of computer	Ap	20%
CO4	Know processor organization and design	Ap	20%
CO5	Understand mapping between virtual and physical memory	An	20%

UNIT I - DIGITAL FUNDAMENTALS	**(9)**
Number Systems and Conversions – Boolean Algebra and Simplification – Minimization of Boolean Functions – Logic Gates – NAND – NOR Implementation.	
UNIT II - BASIC STRUCTURE OF COMPUTERS	**(9)**
Functional units – Basic operational concepts – Bus structures – Performance and Metrics – Instruction and instruction sequencing – Hardware – Software Interface.	
UNIT III - ADDRESSING MODES AND ALU	**(9)**
Addressing modes – Instructions sets – RISC and CISC – ALU design – Fixed point and Floating point operation.	
UNIT IV - PROCESSOR DESIGN	**(9)**
Processor basics – CPU Organization – Data path design – Control design – Basic concepts – Hard wired control – Micro programmed control – Pipeline control.	
UNIT V - MEMORY AND I/O SYSTEM	**(9)**
Memory systems – Virtual memory – Caches – Design methods – Associative memories – Input / Output system – Programmed I / O – DMA and Interrupts.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES:

1. Morris Mano, "Digital Design", Fourth Edition, Prentice Hall of India, 2007.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Eighth Edition, Pearson Education, 2010.
4. Charles H. Roth, Jr., "Fundamentals of Logic Design", Eighth Edition, Jaico Publishing House, Mumbai, 2004.
5. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Fourth Edition, Morgan Kaufmann, 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2	2									2		
2		2									2			
3	3		2											
4	3										2			
5		2										2		
CO	3	2	2								2	2