COIMBATORE INSTITUTE OF TECHNOLOGY, COIMBATORE – 641 014
(An Autonomous Institution affiliated to ANNA UNIVERSITY, CHENNAI)
DEPARTMENT OF INFORMATION TECHNOLOGY
REGULATIONS 2023 CHOICE BASED CREDIT SYSTEM

VISION

To evolve as a Centre of Excellence in teaching, learning, research and consultancy, integrating computer and information sciences with engineering concepts to develop products and services for the benefits of the industry and society at large.

MISSION

- To impart value based technical education and entrepreneurial skills to the graduates through state of art infrastructure.

- To educate graduates, towards the design and development of intelligent products and services meeting global demands and standards.

- To promote collaborative learning and research with industry, government and International organizations for continuous knowledge transfer and enhancement.

- To develop globally competent engineers capable of providing secure and "Out-of-the Box" computing and information technology solutions.

- To enable the graduates to adapt to the rapidly changing technology with strong fundamentals.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1: Graduates will acquire sound knowledge in mathematical, scientific and engineering fundamentals and knowledge in Information and Communication Technology to analyze, formulate and solve the real-life problems.

PEO 2: Graduates will encompass entrepreneurship skills and ability to develop, implement innovative, integrated and secure information technology solutions for meeting the global challenges and changing requirements.

PEO 3: Graduates will possess professional and ethical attitude, leadership qualities, desire for lifelong learning, and ability to work in multidisciplinary teams in meeting the broader societal needs.

PROGRAM OUTCOMES (POs)

1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2 **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3 **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6 **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7 **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Ability to design and develop cost effective, secure, reliable IT and network products and solutions using emerging tools and techniques for meeting the global needs.

PSO2: Ability to identify and analyze voluminous and heterogeneous data by applying suitable evolutionary algorithms, statistical techniques and analytical tools to facilitate information retrieval, pattern discovery, predictive modeling and decision making in scientific and business applications.

MAPPING OF PROGRAMME EDUCATIONAL OUTCOMES WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

PEOs	PROGRAMME OUTCOMES												PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	3	3	3							2	3	3
2				2	3	3	3					2	3	3
3								3	3	3	3	2		

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CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1	23FYH111	Technical English	HSC	2	2	0	4	4
T2	23FYM115	Matrices and Vector Calculus	BSC	3	1	0	4	4
T3	23FYP115	Applied Physics	BSC	3	0	0	3	3
T4	23FYC115	Applied Chemistry-I	BSC	3	0	0	3	3
T5	23IT111	Problem Solving using C	ESC	3	0	0	3	3
PRACTICALS								
P1	23FPC122	Basic Sciences Laboratory	BSC	0	0	4	4	2
P2	23IT121	Engineering Graphics	ESC	0	0	4	4	2
P3	23IT122	C Programming Laboratory	ESC	0	0	2	2	1
MANDATORY COURSES								
MC1	23MC101	Induction Programme	MC	15 Days			-	-
MC2	23FYH121	Heritage of Tamils	MC	15 Hrs			-	1
MC3	23MC102	Soft Skills	EEC	15 Hrs			-	-
			TOTAL	**14**	**3**	**10**	**27**	**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1	23FYM215	Fourier Series and Differential Equations	BSC	3	1	0	4	4
T2	23IT211	Electronic Devices	BSC	3	0	0	3	3
T3	23IT212	Digital Logic and Design	PCC	3	0	0	3	3
T4	23IT213	Python Programming	PCC	3	0	0	3	3
T5	23IT214	Computational Thinking	PCC	3	0	0	3	3
PRACTICALS								
P1	23FYH221	English Communication Competency Laboratory	HSC	0	0	4	4	2
P2	23IT221	Digital Logic and Design Laboratory	PCC	0	0	2	2	1
P3	23IT222	Python Programming Laboratory	PCC	0	0	2	2	1
MANDATORY COURSES								
MC1	23CC221 23CC222 23CC223 23CC224	Cocurricular Activities* NSS YRC RSP Sports	MC	15 Hrs			-	1
MC2	23FYC221	Environmental Science and Engineering	MC	15 Hrs			-	1

MC3	23FYH222	Tamils and Technology (தமிழரும் தொழில்நுட்பமும)	MC	15 Hrs			-	1
TOTAL				**15**	**1**	**8**	**24**	**23**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1		Linear Algebra, Complex Variables and Transforms	BSC	3	1	0	4	4
T2		Data Structures and Algorithms-I	PCC	3	1	0	4	4
T3		Computer Organization and Architecture	PCC	3	0	0	3	3
T4		Object Oriented Paradigms and Java	PCC	3	0	0	3	3
T5		Database Systems	PCC	3	0	0	3	3
PRACTICALS								
P1		Data Structures and Algorithms Laboratory	PCC	0	0	2	2	1
P2		Database Systems Laboratory	PCC	0	0	2	2	1
P3		Object Oriented Paradigms and Java Laboratory	PCC	0	0	4	4	2
MANDATORY COURSES								
MC1		INDUCTION PROGRAMME	MC	1 Week			-	-
MC2		Human Values and Professional Ethics	MC	15 Hrs			-	1
MC3		Design Thinking	EEC	15 Hrs			-	1
			TOTAL	**15**	**2**	**8**	**25**	**23**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1		Discrete Mathematics and Automata Theory	PCC	3	1	0	4	4
T2		Computer Networks	PCC	3	0	0	3	3
T3		Internet Technology and Web Services	PCC	3	0	0	3	3
T4		Principles of Operating Systems	PCC	3	0	0	3	3
T5		Data Structures and Algorithms-II	PCC	3	1	0	4	4
PRACTICALS								
P1		Computer Network Programming Laboratory	PCC	0	0	4	4	2
P2		Internet Technology and Web Services Laboratory	PCC	0	0	4	4	2
P3		Operating Systems Laboratory	PCC	0	0	2	2	1
MANDATORY COURSES								
MC1		Value Added Course I	EEC	15 Hrs			-	-
MC2		Community Services and Engineering	MC	15 Hrs			-	-
			TOTAL	**15**	**2**	**10**	**27**	**22**

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1		Statistics for Data Science and Data Mining	PCC	3	1	0	4	4
T2		Principles of Software Engineering	PCC	3	0	0	3	3
T3		Embedded Systems and IoT	PCC	3	0	0	3	3
T4		ELECTIVE –I	PEC	3	0	0	3	3
T5		ELECTIVE –II	PEC	3	0	0	3	3
PRACTICALS								
P1		Embedded Systems and IoT Lab	PCC	0	0	2	2	1
P2		Data Mining Lab	PCC	0	0	4	4	2
P3		Open Source Systems Lab	PCC	0	0	2	2	1
		INPLANT TRAINING	EEC	14 days			-	1
MANDATORY COURSES								
MC1		Seminar And Technical Writing	EEC	15 Hrs			-	1
MC2		Value Added Course II	EEC	15 Hrs			-	-
			TOTAL	**15**	**1**	**8**	**24**	**22**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1		Artificial Intelligence	PCC	3	0	0	3	3
T2		Cryptography and Network Security	PCC	3	0	0	3	3
T3		Machine Learning	PCC	3	0	0	3	3
T4		ELECTIVE -III	PEC	3	0	0	3	3
T5		ELECTIVE -IV	PEC	3	0	0	3	3
PRACTICALS								
P1		Artificial Intelligence Laboratory	PCC	0	0	2	2	1
P2		Data Visualization Laboratory	PCC	0	0	4	4	2
P3		Mobile Application Development Laboratory	PCC	0	0	2	2	1
		MINI PROJECT	EEC	0	0	4	4	2
MANDATORY COURSES								
MC1		Hackathon	MC	15 Hrs			-	1
			TOTAL	**15**	**0**	**12**	**27**	**22**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1		Big Data Analytics	PCC	3	0	0	3	3
T2		Cyber-Physical Systems	PCC	3	0	0	3	3
T3		Full Stack Development	PCC	3	1	0	4	4
T4		ELECTIVE –V	PEC	3	0	0	3	3
T5		ELECTIVE –VI	PEC	3	0	0	3	3
PRACTICALS								
P1		Full Stack Development Laboratory	PCC	0	0	2	2	1
P2		Big Data Analytics Laboratory	PCC	0	0	4	4	2
P3		DevOps Laboratory	PCC	0	0	2	2	1
			TOTAL	**15**	**1**	**8**	**24**	**21**

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
T1		ELECTIVE –VII	PEC	3	0	0	3	3
T2		ELECTIVE -VIII	PEC	3	0	0	3	3
PRACTICALS								
P1		PROJECT WORK AND VIVA-VOCE	EEC	0	0	12	12	6
			TOTAL	**6**	**0**	**12**	**18**	**12**

LIST OF PROFESSIONAL ELECTIVE COURSES:

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.		Advanced Algorithms	PE	3	0	0	3	3
2.		Advanced Computer Architecture	PE	3	0	0	3	3
3.		Compiler Design	PE	3	0	0	3	3
4.		Computer Vision and Image Processing	PE	3	0	0	3	3
5.		Distributed Systems	PE	3	0	0	3	3
6.		Edge and Fog Computing	PE	3	0	0	3	3
7.		Graph Theory	PE	3	0	0	3	3
8.		Graphics and Multimedia Systems	PE	3	0	0	3	3
9.		Image and Video Analytics	PE	3	0	0	3	3
10.		Open Source Systems	PE	3	0	0	3	3
11.		Optimization Techniques	PE	3	0	0	3	3

12.		Parallel Computing	PE	3	0	0	3	3
13.		Soft computing	PE	3	0	0	3	3
14.		User Experience (UX) Design for Extended Reality (XR)	PE	3	0	0	3	3

LIST OF OPEN ELECTIVE COURSES OFFERED FOR THE STUDENTS OF OTHER UG PROGRAMMES:

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C	UG PROGRAMME
1.		Programming in java	OE	3	0	0	3	3	Civil, Mech, EEE, ECE, Chemical
2.		Cloud Computing Fundamentals	OE	3	0	0	3	3	Civil, Mech, EEE, ECE, Chemical
3.		Information Security Fundamentals	OE	3	0	0	3	3	Civil, Mech, EEE, ECE, Chemical

LIST OF MAJOR VERTICALS:

DATA ANALYTICS:

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.		Deep Learning		3	0	0	3	3
2.		Business Intelligence		3	0	0	3	3
3.		Social Network Analysis		3	0	0	3	3
4.		Natural Language Processing		3	0	0	3	3
5.		Web Mining		3	0	0	3	3
6.		Healthcare Data Analytics		3	0	0	3	3

CLOUD APPLICATIONS AND SERVICES:

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.		Cloud Computing		3	0	0	3	3
2.		Virtualization Techniques		3	0	0	3	3
3.		Cloud Native Application Development		3	0	0	3	3
4.		Virtual Reality and Augmented Reality		3	0	0	3	3
5.		Semantic Web		3	0	0	3	3
6.		Human Computer Interaction		3	0	0	3	3

NETWORKS AND SECURITY:

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.		Mobile Computing		3	0	0	3	3
2.		Advanced Computer Networks		3	0	0	3	3
3.		Digital and Mobile Forensics		3	0	0	3	3
4.		Blockchain Technology		3	0	0	3	3
5.		Cyber Security		3	0	0	3	3
6.		Ethical Hacking		3	0	0	3	3

SOFTWARE PROCESS AND MANAGEMENT:

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.		Software Metrics and Measurement		3	0	0	3	3
2.		Software Testing and Quality Assurance		3	0	0	3	3
3.		Customer Relationship Management		3	0	0	3	3
4.		Enterprise Resource Planning		3	0	0	3	3
5.		Software Project Management		3	0	0	3	3
6.		Agile Technology		3	0	0	3	3

LIST OF MINOR VERTICALS:

DATA SCIENCE:

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	CREDITS
1.		Database Systems		3	0	0	3	3
2.		Data Structures and Algorithms		3	0	0	3	3
3.		Statistics for Data Science		3	0	0	3	3
4.		Applied Data Science using Python		3	0	0	3	3
5.		Applied Machine Learning		3	0	0	3	3
6.		Data Visualization		3	0	0	3	3
7.		Data Engineering		3	0	0	3	3

SUMMARY

Category; BSC – Basic sciences, HSC– Humanities and Social Sciences, ESC–Engineering sciences, PCC –Professional Core, PEC- Professional Elective, OEC-Open Elective Course, EEC –Employability Enhancement Course, MC – Mandatory Course

SI. No.	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	HSC	4	2	-	-	-	-	-	-	6
2	BSC	12	7	4	-	-	-	-	-	23
3	ESC	6	-	-	-	-	-	-	-	6
4	PCC	-	11	17	22	14	13	14	6	97
5	PEC	-	-	-	-	6	6	6	-	18
6	OEC	-	-	-	-	-	-	-	-	0
7	EEC	-	-	1	-	2	2	-	6	11
8	MC	1	3	1	-	-	1	-	-	6
							TOTAL CREDITS			167

B.Tech Information Technology

COURSE CODE	LINEAR ALGEBRA, COMPLEX VARIABLES AND TRANSFORMS	L	T	P	C
		3	1	0	4

MODULE I VECTOR SPACES 9+3

Vector Spaces - Linear Independence - Basis and Rank- Linear Mappings- Matrix Representation of Linear Mappings- Basis Change. Inner Products- Lengths and Orthogonality - Orthogonal sets Orthogonal Projections (Gram-Schmidt Orthogonalization only).

MODULE II MATRIX DECOMPOSITIONS 9+3

Matrix Decompositions- Determinant and Trace- Eigen values and Eigenvectors- Cholesky Decomposition- Singular value Decomposition.

MODULE III COMPLEX DIFFERENTIATION 9+3

Analytic functions – Necessary and sufficient conditions –Cauchy-Riemann equations - Properties of analytic functions– Harmonic conjugates – Construction of analytic function. Bilinear transformation.

MODULE IV COMPLEX INTEGRATION 9+3

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor and Laurent series - Singularities – Residues – Cauchy's Residue theorem.

MODULE V FOURIER TRANSFORMS 9+3

Fourier transform pair – Sine and Cosine transforms –Properties (Without proof) –Applications to evaluate simple real integrals- Transforms of simple functions –Parseval's identity.

COURSE OUTCOMES

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

CO 1: Incorporate suitable methods of linear mappings and orthogonal projections and implement the same for applications in machine learning algorithms.

CO 2: Learn the concepts of matrix decompositions and implement them in Programming problems.

CO 3: Examine the standard techniques of complex variable, analytic function and its properties.

CO 4: Gain knowledge on the ideas of complex integration.

CO 5: Understand the Fourier transform techniques and use it for solving various Engineering problems.

CO 6: Apply the concepts of Linear algebra and complex variables in real life problems.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 44thEdition, 2021.
2. David C. Lay, "Linear Algebra and its Applications", 6th Edition, Pearson Education, 2021.

REFERENCES:

1. Gilbert Strang, "Introduction to Linear Algebra", Wellesley Cambridge Press and SIAM,6th Edition,2022.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley& Sons ,10th   Edition, 2015.

3. B.V.Ramana, "Higher Engineering Mathematics", Tata MC Graw-Hill Publishing Company Limited, Kindle Edition, 2018.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	1	-	-	-	-	-	-	-	-	1	-	1
2	3	3	1	-	-	-	-	-	-	-	-	1	-	1
3	3	3	1	-	-	-	-	-	-	-	-	1	-	1
4	3	3	1	-	-	-	-	-	-	-	-	1	-	1
5	3	3	1	-	-	-	-	-	-	-	-	1	-	1
6	3	3	1	-	-	-	-	-	-	-	-	1	-	1
Avg.	3	3	1	-	-	-	-	-	-	-	-	1	-	1

1-Low, 2-Medium, 3-High

COURSE CODE	DATA STRUCTURES AND ALGORITHMS – I	L	T	P	C
		3	1	0	4

MODULE I ALGORITHM ANALYSIS AND ARRAYS   10

Data Vs Information - Definition of an Algorithm - Basic Steps in Development of an Algorithm – Sparks Notation - Algorithm Complexity - Space and Time Complexity - Order Notations- Definition - Arrays: Representation, Characteristics - Polynomial Representation- Polynomial Addition- Multidimensional Arrays. String Representation: Fixed Length, Workspace Index- Operations: Insertion, Deletion, Pattern Matching.

MODULE II STACKS AND QUEUES   8

Fundamentals of Stacks, Queues, Circular Queue and Dequeues - Application of Stacks: Recursion – Conversion of Infix to Postfix and Prefix Expressions - Evaluation of Postfix Expressions - Application of Queues: Rat in Maze-Priority Queue-Multiple Stacks and Queues.

MODULE III LINKED LISTS AND SPARSE MATRICES   9

Singly and Doubly Linked Lists: Basic Operations - Linked Stacks and Queues - Polynomial Manipulation-Addition.
Sparse Matrix Representation - Transpose and Addition of Sparse Matrices in Three Tuple Form - Sparse Matrices using Linked Lists.

MODULE IV   TREES   9

Definition – Trees, Binary Trees - Representations, Tree Traversals, Threaded Binary Trees -Tree Traversals in Threaded Binary Trees- Copy and Equivalence of Binary tree- Binary Tree Representation of General Trees – Binary Search Tree-Insertion and Deletion- Decision Trees.

MODULE V GRAPHS   9

Terminology and Representations - Graph Traversals – Bi-connectivity - Connected Components - Spanning Trees - Transitive Closure - Shortest Path Algorithms – Dijkstra Algorithm-Floyd-Warshall Algorithm- Activity Networks -Topological Sorting -Critical Paths.
* Note: Algorithms will be taught in Sparks-like notation.

COURSE OUTCOMES

At the end of the course, students will be able to
CO1: Describe the representation of arrays and string and analyze the complexity of algorithms
CO2: Apply Linear data structures such as lists, stacks, queues, linked list to solve real world problems
CO3: Develop algorithms using Arrays and Linked list and its applications
CO4: Demonstrate suitable data structures for Sparse Matrix and its application.
CO5: Apply various Tree data structures to solve problems
CO6:Develop algorithms using graphs and its applications

                                                                    TOTAL : 60 PERIODS
TEXT BOOKS:

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Publications, Second Edition, 2008.

2. Jean-Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill, Second edition, 2008.

REFERENCES:
1. Satraj Sahani, "Data structures, Algorithms and applications in C++", McGraw Hill, Second Edition,2005.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	3	2	3								2	2	3
2	3	3	2	2								2	2	3
3	3	3	3	3								2	2	3
4	3	1	2	2								2	2	3
5	3	3	2	3								2	2	3
6	3	3	2	3								2	2	3
Avg.	3	3	2	3								2	2	3

1-Low, 2-Medium, 3-High

COURSE CODE	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

MODULE I   MACHINE INSTRUCTIONS AND ARITHMETIC OPERATIONS   10

Memory Locations and Addresses : Byte Addressability - Big-Endian and Little-Endian-Word Alignment -Accessing Numbers and Characters. Instruction and Instruction sequencing: Register Transfer Notation – Assembly Language Notation – RISC and CISC Instruction Sets – Instruction Execution and Straight Line Sequencing – Branching. Addressing modes – Stacks – Subroutines - RISC and CISC styles. Arithmetic algorithms for Additions, Subtraction, Multiplication and Division using 2's complement numbers and Floating point Numbers.

MODULE II   BASIC PROCESSING UNIT   9

Fundamental Concepts - Instruction Execution: Load - Store - Arithmetic and Logical Instructions. Hardware components: Register File – ALU - Data path - Instruction Fetch Section.

Instruction Fetch and Execution Steps: Branching – Waiting for Memory. Control signals – Hardwired Control: Data path Control Signals – Dealing with Memory Delay. CISC Style Processor: Interconnect using Buses - Micro programmed Control.

MODULE III   PIPELINING   9

Basic Concepts – Pipeline Organization – Pipelining Issues – Data Dependencies: Operand Forwarding – Handling Data Dependencies in Software. Memory Delays – Branch Delays: Unconditional Branches – Conditional Branches – Branch Delay Slot - Branch Prediction. Resource limitations – Performance Evaluation: Effects of stalls and penalties - Number of pipeline stages. Superscalar Operation: Branches and Data Dependencies – Out-of-Order Execution – Execution Completion - Dispatch Operation.

MODULE IV   MEMORY SYSTEM   8

Memory Hierarchy - Memory Address Map - Memory Connection to CPU – Associative Memory: Hardware Organization - Match Logic - Read and Write Operation. Cache Memory: Associative mapping - Direct Mapping - Set Associative Mapping - Writing into Cache - Cache Initialization. Virtual Memory: Address Mapping using Pages – Associate Memory – Page Table – Page Replacement.

MODULE V   I/O ORGANIZATION   9

Accessing I/O Devices: I/O Device Interface - Program-Controlled I/O. Interrupts: Enabling and Disabling Interrupts – Handling Multiple Devices. Direct Memory Access - Bus Structures – Bus Operation: Synchronous Bus – Asynchronous Bus. Arbitration – Interface circuits: Parallel Interface – Serial Interface

COURSE OUTCOMES

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

CO1: Describe machine instructions and operand addressing modes used in processors.

CO2: Apply algorithms for performing arithmetic operations, using the registers and ALU within the processor.

CO3: Illustrate the control sequences and draw a data flow path during the instruction execution.

CO4: Examine hazards in pipelining and techniques to enhance the performance of the system.

CO5: Choose the appropriate memory mapping procedure to enhance the performance of the system.

CO6:   Outline the communication of I/O interface and ports with the processor

TEXT BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraj Manjikian, "Computer Organization and Embedded Systems", McGraw-Hill, Sixth Edition, 2022.
2. Morris Mano and Rajib Mall, "Computer System Architecture ", Pearson, 2017. (for Arithmetic Algorithms and Memory System).

REFERENCES:

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, Eleventh Edition, 2022.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware / Software Interface", Morgan Kaufmann, Sixth Edition, 2021.
3. John P. Hayes, "Computer Architecture and Organization", McGraw Hill, Third Edition,2017.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	-	-	-	-	-	-	-	-	-	1	2	-
2	3	3	-	-	-	-	-	-	-	-	-	1	2	-
3	3	3	-	-	-	-	-	-	-	-	-	1	2	-
4	2	2	2	-	-	-	-	-	-	-	-	1	2	-
5	2	3	-	-	-	-	-	-	-	-	-	1	2	-
6	2	2	2	-	-	-	-	-	-	-	-	1	2	-
Avg.	2	3	2	-	-	-	-	-	-	-	-	1	2	-

1-Low, 2-Medium, 3-High

COURSE CODE	OBJECT ORIENTED PARADIGMS AND JAVA	L	T	P	C
		3	0	0	3

MODULE I   OBJECT ORIENTED PROGRAMMING   **5**
Introduction to object oriented languages - Evolution of object oriented languages - Object oriented programming paradigm -Basic concepts of object oriented programming - Procedural vs Object oriented programming.

MODULE II   INTRODUCTION   **6**
Java and Internet – Byte Code - Features of Java - Java Development Environment- Java Programming: Methods and Classes- Constructor - Garbage Collection - Overloading - Inheritance - Overriding.

MODULE III   PACKAGES , STRINGS AND EXCEPTION HANDLING   **11**
Packages and Interfaces - Java I/O systems-String Handling : String and String Buffer Exception Handling: Fundamentals of Exception handling and types - Built in Exceptions - User defined Exceptions.

MODULE IV   THREADS AND NETWORKING   **12**
Multithreaded Programming : Thread Model - The Main Thread - Creating a Thread - Creating Multiple Threads – Thread priorities - Synchronization - Inter thread communication - Networking : Networking Basics - Inet address - TCP/IP Sockets -URL - Datagrams.

MODULE V   AWT AND DATABASE CONNECTIVITY   **12**
Event Handling: The Delegation Event Model - Event class: Keyboard and Mouse events handling.-
Introducing the AWT-AWT Classes-window Fundamentals-Creating a Frame Window in an Applet Working with Graphics-Using AWT Controls, Layout Managers and Menus: Buttons, Text Field, checkbox - Database Connectivity: basic structure of JDBC API.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1 : Apply the object oriented concepts in specific applications.
CO2 : Identify the classes and objects in real world software applications.
CO3: Choose the proper Exception Handling techniques to handle the exceptions in programs.
CO4 : Demonstrate the concepts of multithreading and networking concepts.
CO5: Utilize the AWT packages to develop the web based applet applications.
CO6: Develop real world applications using database connectivity.

                                                                     TOTAL : 45 PERIODS

TEXT BOOKS:
1. Herbert Schildt, " Java The Complete Reference ", Tata McGraw Hill, McGraw Hill Education, Twelfth Edition, 2021.
REFERENCES:
1.   Deitel H.M and Deitel P.J, " Java - How to Program", Prentice Hall of India, Eleventh Edition, 2018

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	3	-	-	-	-	-	-	-	-	2	2	1
2	2	3	3	3	-	-	-	-	-	-	-	2	2	1
3	2	2	2	3	2	-	-	-	-	-	-	2	2	1
4	3	3	3	3	3	-	-	-	-	-	-	2	2	1
5	3	3	3	3	3	-	-	-	-	-	-	3	2	1
6	3	3	3	3	3	-	-	-	-	-	-	3	3	1
Avg.	3	3	3	3	3	-	-	-	-	-	-	3	2	1

1-Low, 2-Medium, 3-High

COURSE CODE	DATABASE SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

Purpose of DBMS - Applications - Views of data - Data Abstraction - Instances and Schemas - Data Models - Database Languages - Relational Databases - Database Architecture - Database users and administrators - History of Database systems. Entity- Relationship(E-R) Model: Basic concepts - Constraints - E-R Diagram - Weak Entity Sets - Reduction of Relational schemas. BigData - Introduction.

MODULE II   RELATIONAL MODEL   10

Structure of Relational Databases - Relational Algebra Fundamentals - Codd's Rule- Additional and extended relational algebra operations - Null values - Modification of Database.SQL: Basic Structure - Set operations - Aggregate functions - Nested Sub queries - Complex queries - Views - Modification of the database - Integrity constraints - Referential Integrity - Triggers – Assertions - Embedded SQL.

MODULE III   DATABASE DESIGN   7

Features of good relational design - Atomic domains and First Normal Form - Decomposition using Functional Dependencies - Functional Dependency theory - Normalization using Functional Dependencies - Decomposition using Multi-valued Dependencies.

MODULE IV   STORAGE   8

Indexing and Hashing: Basic concepts, Ordered Indices: Dense and Sparse Indices - MultiLevel Indices- Index Update. B+-Tree Index Files: Structure of a B+-Tree - Queries in B+-Trees. Static Hashing, Dynamic Hashing. RAID, Blockchain Databases:Blockchain Properties- Data Management in a Blockchain.

MODULE V   TRANSACTION MANAGEMENT   11

Transaction Concepts and States - Concurrent Executions - Serializability. Concurrency control: Lock Based Protocols: Locks, Granting of Locks, 2-phase locking protocol - Timestamp Based Protocols - Validation based protocols – Deadlock Handling. Recovery Systems: Failure classification - Log based Recovery - Recovery with concurrent Transactions.

COURSE OUTCOMES

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

CO1 : Illustrate the architecture and functioning of database management systems.

CO2 : Construct ER model and derive the relational schemas from the model

CO3 : Apply relational algebra operations and write appropriate SQL queries with suitable constraints for a given database application

CO4 : Apply principles of relational database design to normalize database.

CO5 : Explain various Database Storage structures, access techniques and Indexing methods in Database applications.

CO6 : Apply transaction processing concepts, Concurrency Control mechanism and Database Recovery methods to design Database applications**.**

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F.Korth,S.Sudharshan,"Database System Concepts", McGrawHill, Seventh Edition, 2019.

REFERENCES:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson Education, Seventh Edition, 2017.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill Education, Third Edition, 2014.
3. Peter Rob, CorlosM.Coronel, "Database Systems: Design, Implementation and Management," Thompson Learning Course Technology, Tenth Edition, 2012.
4. Thomas M.Connolly and Carolyn E.Begg, " A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2019.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	-	-	-	-	-	-	-	-	-	1	-	2
2	3	3	2	3	3	-	-	-	-	-	-	1	-	2
3	3	3	3	3	3	-	-	-	-	-	-	1	-	2
4	2	3	3	2	2	-	-	-	-	-	-	1	-	2
5	3	3	2	2	2	-	-	-	-	-	-	2	-	2
6	3	2	1	3	2	-	-	-	-	-	-	1	-	2
Avg	3	3	2	2	2	-	-	-	-	-	-	1	-	2

1-Low, 2-Medium, 3-High

COURSE CODE	DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Operations on Stacks, Queues and Linked List
2. Applications using Stacks and Queues
3. Polynomial operations using Linked List
4. Trees - Binary Tree Traversals, Binary Search Tree operations
5. Traversals on graphs
6. Implementation of shortest path algorithms in Graph
7. Implementation of suitable search algorithms for the given application
8. Implementation of sorting algorithms

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able
CO1: *Selection and application of suitable data structures in implementing practical problems*
CO2: *Apply searching and sorting algorithms that suit the given problem stated*
CO3: *Identify suitable graph based algorithms and apply them for solving problems that arise in the real-world scenarios*

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3	-	-	-	-	-	-	-	3	2	2
2	3	3	3	3	-	-	-	-	-	-	-	3	2	2
3	3	3	3	3	-	-	-	-	-	-	-	3	2	2
AVG	3	3	3	3	-	-	-	-	-	-	-	3	2	2

1-Low, 2-Medium, 3-High

COURSE CODE	DATABASE SYSTEMS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Database Creation, Insertion and Deletion.
2. Queries based on DML commands.
3. Aggregate Functions.
4. Sub-Queries and Joins.
5. Group by clause and DATE functions.
6. Views and Triggers.
7. PL/SQL Procedures.
8. Using Cursors and Functions in PL/SQL blocks.
9. ODBC Connectivity.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1 : Practice various DDL,DML,TCL commands so as to perform various database operations and Solve queries for a given application.

CO2 : Demonstrate open database connectivity by establishing connections between front end and Databases

CO3 : Experiment various PL/SQL features such as procedures, functions, triggers and report generation.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	2	3	-	-	-	-	-	-	2	1	2
2	1	2	3	3	3	-	-	-	-	-	-	2	1	2
3	3	2	3	1	2	-	-	-	-	-	-	2	1	2
AVG	3	2	3	2	3	-	-	-	-	-	-	2	1	2

1-Low, 2-Medium, 3-High

COURSE CODE	OBJECT ORIENTED PARADIGMS AND JAVA LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. Control statements in Java.
2. Classes.
3. Inheritance.
4. Exception Handling.
5. Packages & Interface.
6. Multithreading.
7. AWT Tools and Graphics Programming.
8. Socket programming using TCP and UDP.
9. Case study Database Connectivity

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Create java applications using fundamental object oriented programming Concepts.

CO2 : Demonstrate advanced java concepts like Exception handling, Multithreading and Applets**.**

CO3 : Design and develop java applications for real world problems**.**

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	3	3	3	3	2	-	-	-	-	-	-	2	2	1
2	3	3	3	3	3	-	-	-	-	-	-	2	3	1
3	3	3	3	3	3	-	-	-	-	-	-	2	3	1
AVG	3	3	3	3	3	-	-	-	-	-	-	2	3	1

1-Low, 2-Medium, 3-High

COURSE CODE	DISCRETE MATHEMATICS & AUTOMATA THEORY	L	T	P	C
		3	1	0	4

MODULE I   MATHEMATICAL LOGIC AND INFERENCE THEORY   9+3
Connectives – Statement Formulas and Truth tables- Well-formed formulas- Tautologies- Equivalence of Formulas-Duality Law- Tautological Implications- Functionally complete sets of connectives- other Connectives- Disjunctive and Conjunctive normal forms- Principals of Disjunctive and Conjunctive normal forms. Rules of inferences – Consistency of premises and indirect method of proof.

MODULE II   ALGEBRAIC STRUCTURES I   9+3
Rings, Integral domains, and Fields - Properties - Polynomial Rings - Construction of Finite Fields; Irreducible Polynomials - Primitive element of a Finite Field - Primitive Irreducible Polynomials.

MODULE III   ALGEBRAIC STRUCTURES II   9+3
Residue arithmetic for Computers - Coding theory - Error Detection - Correction – Hamming Distance - Minimum distance - Group Code, Linear Code and Cyclic Codes – Single error correction; Encoding and Decoding Techniques.

MODULE IV   FINITE AUTOMATA   9+3
Chomsky Classification of Grammars- Context free grammars -Finite State Automata – Definition – Transition diagrams – Deterministic & Nondeterministic Finite Automata – Finite Automata with Є moves - Finite State Automata with output – Moore & Mealy Machine.

MODULE V   TURING MACHINES   9+3
Turing Machines: Definition– well formedness of parentheses – Addition and Multiplication of unary numbers – Recognition of binary palindromes – Recognition of words of the form 0^n, 1^n.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: Apply logical reasoning in verifying the correctness and validity of simple instances of valid logical arguments and learn the basic concepts of Inference theory to acquire knowledge to solve the problems.
CO2: Solve the problems in the area of rings, integral domains and fields.
CO3: Illustrate various algebraic structures and their properties and design encoding and decoding procedures for error detection and correction.
CO4: Acquire knowledge in constructing system models which are the natural extension of Automata that is used to devise decision procedures.
CO5: Learn the basic concepts of the Turing machine and apply it in providing a powerful computation model for solving engineering problems.
CO6: Apply the basic concepts of Inference theory, algebraic structures, and automata theory in solving real life problems.

                                                                  TOTAL : 60 PERIODS

TEXT BOOKS:

1. Tremblay J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata Mc Graw Hill Pub.Co. Ltd,New Delhi, 30th Reprint, 2011.

2. John E.Hopcroft, Rajeev Motwani, Jeffery D.Ullman, " Introduction of Automata Theory, Languages and Computation", Addison Wesley, Pearson Education, 3rd edition , Second Impression,2009.

REFERENCES:

1. Kenneth H Rosen, "Discrete Mathematics with Applications", Tata McGraw Hill, 8thEdition, 2021.
2. K.L.P Mishra, N.Chandrasekaran " Theory of Computer Science", Prentice,Hall of India Private Limited, Third Edition, 2006.
3. Grimaldi R.P, "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education Asia, Fifth Edition, Delhi, 2019.
4. John.C.Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata Mcgraw-Hill, seventh reprint,2010.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	1	-	-	-	-	-	-	-	-	1	-	1
2	3	3	1	-	-	-	-	-	-	-	-	1	-	1
3	3	3	1	-	-	-	-	-	-	-	-	1	-	1
4	3	3	1	-	-	-	-	-	-	-	-	1	-	1
5	3	3	1	-	-	-	-	-	-	-	-	1	-	1
6	3	3	1	-	-	-	-	-	-	-	-	1	-	1
Avg.	3	3	1	-	-	-	-	-	-	-	-	1	-	1

1-Low, 2-Medium, 3-High

COURSE CODE	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9
Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet, Connection oriented network - X.25, frame relay. THE PHYSICAL LAYER: Theoretical basis for communication, guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system.

MODULE II   THE DATA LINK LAYER   9
Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet. THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth.

MODULE III   THE NETWORK LAYER   9
Network layer design issues, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service.

MODULE IV   THE TRANSPORT LAYER   9
Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP.

MODULE V   THE APPLICATION LAYER   9
Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http. APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1 : Describe the layered architecture of computer networks, factors influencing the performance of networks.
CO2 : Describe the link layer access protocols and their functions in networking.
CO3 : Discuss the Network layer and routing protocols used in computer networks.
CO4 : Demonstrate the working of TCP and UDP protocols.
CO5 : Discuss the services of application layer protocols
CO6: Develop applications for client server models using socket functions.

TOTAL : 45 PERIODS

TEXT BOOKS:
1. A. S. Tanenbaum (2018), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

REFERENCES:
1. Behrouz A. Forouzan (2017), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.
2. Kurose, Ross (2017), Computer Networking: A top down approach, Pearson Education, India.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	2	-	-	-	-	-	-	-	-	-	2	1
2	2	1	1	-	-	-	-	-	-	-	-	-	2	1
3	3	2	2	1	1	-	-	-	-	-	-	1	2	2
4	2	1	2	-	-	-	-	-	-	-	-	-	2	1
5	2	2	2	1	2	1	-	-	-	-	-	1	2	2
6	2	2	2	1	2	1	-	-	-	-	-	-	2	-
Avg.	2	1	2	1	2	1	-	-	-	-	-	1	2	1

1-Low, 2-Medium, 3-High

COURSE CODE	INTERNET TECHNOLOGY AND WEB SERVICES	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9
Basic Web Concepts - Web based Client/Server model -Web Protocols- Working of web browser - Browser & Server Communication - History of HTML / XHTML / HTML5 – HTML5 Structural Elements-Images – HTML5 Form Elements and Attributes- DHTML- CSS3- Selectors- Positioning   elements- Colors-Shadows-Gradients–Transitions   and   Transformations.

MODULE II   XML   9
Introduction to XML - XML fundamentals - Well-formed XML documents - XML Namespaces - Document Object Model (DOM) - Simple API for XML(SAX) - Extensible Stylesheet Languages (XSL).

MODULE III   SCRIPTING LANGUAGES   9
Client Side scripting - Introduction to Java Script – Arrays –   Control statements –Events – Cookies - Introduction to CGI Concepts - Server Side Technologies: Java Server Pages - System Architecture - Basic JSP life cycle-JSP elements: Variables and objects – Methods-Implicit objects-Parsing Request Strings-Session Management. - Java Servlets - Servlet life cycle.

MODULE IV   APPLICATION DEVELOPMENT USING NODE JS   9
Introduction to Node.js- Installing Node.js - Using Events, Listeners, Timers, and Callbacks in Node.js – Introduction to MongoDB - Accessing MongoDB from Node.js.

MODULE V   WEB SERVICES BUILDING BLOCKS   9
Architecting Web Services: Business motivations for web services, B2B, B2C-Web Services Building Blocks: SOAP,   WSDL, UDDI-Creating, Publishing ,Testing and Describing a Web services - Microservices Introduction

COURSE OUTCOMES
At the end of the course, students will be able to
  CO1: Design static web pages using HTML5 and CSS.
  CO2: Design, validate, parse and display XML documents.
  CO3: Apply client side scripting to web pages .
  CO4: Develop web pages using JSP Server Side Scripting.
  CO5: Develop web applications using NodeJs.
  CO6:Design Web Services using technologies such as SOAP, WSDL, UDDI.

                                                                              TOTAL : 45 PERIODS

TEXT BOOKS:

1. Deital & Deital, "Internet and World Wide Web-How to Program", Pearson Education Fifth Edition, 2023.

2. Brad Dayley, Brendan Dayley, and Caleb Dayley , Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications, 2nd Edition, Pearson Education, 2018

3. Ron Schmelzer et al. " XML and Web Services", Pearson Education, 2008.

REFERENCES:

1. Robert W.Sebesta, "Programming with World Wide Web", Pearson Education, Eighth Edition, 2020.(Web Based Applications and its Technologies)
2. Jeffrey C. Jackson," Web Technologies: A Computer Science Perspective", Pearson Education, Second Edition 2007
3. RashimMogha, V.V Preetham. V.V. "Java Web Services Programming", Wiley Dream tech, New Delhi, Java 2 Enterprise Edition, 2011. (Server Side Technologies)

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		3		2								3	2
2	2	2	2		2								3	2
3	3	2	3		3								3	2
4	2	3	3		3								3	2
5	3	3	3	2	3								3	2
6	2	2	2	2	3								3	2
Avg.	2	3	3	2	3								3	2

1-Low, 2-Medium, 3-High

COURSE CODE	PRINCIPLES OF OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I   OPERATING SYSTEM OVERVIEW   7

Introduction to system software - Objectives and functions of OS - Evolution of OS - Distributed system - Characterization of Distributed Systems- Resource Sharing - Challenges - Real-Time systems - Operating system components - Interrupts -System call - Virtual machines - Symmetric Multiprocessing - Microkernel.

MODULE II   PROCESS DESCRIPTION AND CONTROL   10

Process - Process states - Process description - Process control -Processes and Threads - Uniprocessor Scheduling: Types of Processor Scheduling - Scheduling Algorithms: FCFS, SPN, SRT, Round Robin, Priority, Multi-Level Queue, Multi-level Feedback and Fair Share Scheduling.

MODULE III   MUTUAL EXCLUSION AND SYNCHRONIZATION   10

Principles of Concurrency - Mutual Exclusion: Software and Hardware Approaches - Semaphores - Monitors - Message Passing- Readers/ Writers problem. Deadlock and Starvation: Principles of deadlock - Deadlock Prevention - Deadlock Detection - Deadlock Avoidance.

MODULE IV   MEMORY MANAGEMENT   10

Memory Management Requirements - Memory Partitioning - Loading and Linking - Paging - Segmentation. Virtual Memory: Hardware and Control Structures – Virtual Memory Management Policies: Fetch Policy, Placement Policy, Replacement Policy- Resident Set Management - Cleaning policy - Load Control.

MODULE V   I/O MANAGEMENT AND FILE MANAGEMENT   8

I/O devices - Organization of I/O function - OS design issues - I/O buffering - Disk scheduling. File Management: Overview - File Organization and Access - File Directories - File Sharing - Record Blocking - Secondary Storage Management.

COURSE OUTCOMES

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

CO1: Outline the basic functionalities of operating systems, operating system components, various types of operating system and system software.

CO2: Apply process scheduling to demonstrate process execution.

CO3: Interpret various process synchronization techniques.

CO4: Make use of principles and methods for handling deadlocks

CO5: Describe various memory management schemes and apply the various virtual memory management policies for efficient memory allocation

CO6: Outline various I/O and File management techniques

TOTAL : 45 PERIODS

TEXT BOOKS:

1. William Stallings, "Operating Systems Internals and Design Principles", Pearson Education, Ninth Edition, 2021.

REFERENCES:

1. Silberchatz, Galvin, Gagne, "Operating System Concepts", John Wiley, Tenth Edition, 2018.

2. Dhananjay M. Dhamdhere, "Operating System a Concept Based Approach " McGraw Hill Publication, Third Edition ,2017.

3. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Pearson Education, Fifth Edition, 2021.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2	2								1	2	1
2	3	3	2	2								1	2	1
3	2	2	2	2								1	2	1
4	3	3	2	2								1	2	1
5	3	2	2	2								1	2	1
6	2	2	2	2								1	2	1
Avg.			2	2								1	2	1

1-Low, 2-Medium, 3-High

COURSE CODE	DATA STRUCTURES AND ALGORITHMS – II	L	T	P	C
		3	1	0	4

MODULE I   SORTING   9
Internal Sorts: Selection Sort, Bubble Sort, Insertion Sort, Merge Sort, Shell Sort, Heap Sort, Quick Sort, Radix Sort, Address Calculation Sort - External Sorts: Polyphase Sort, Oscillating Sort, Sorting on Discs-Extended Run List-Time Complexity for Sorting Algorithms.

MODULE II   SEARCH STRATEGIES   9
Sequential Search - Binary Search - Search Trees: Height Balanced Trees (AVL)- Red-Black Trees-Weight Balanced Trees, B-Trees, B+ Trees - Tries- Time Complexity for Searching Algorithms.

MODULE III   HASHING AND FILE ORGANIZATION   9
Introduction-Hashing Methods- Collision Resolution Techniques - File Organization - Sequential Files - Indexed Sequential Files: Structure and Processing - Direct Files- Multiple Key Access: Multilist-Inverted List - Inode Data Structure- FAT Data Structure.

MODULE IV   ALGORITHM DESIGN TECHNIQUES I   9
Problem-Solving Heuristics-Sub Goals, Hill Climbing, and Working Backward, Algorithm Design Methods-Definition of P, NP, NP Hard, NP Complete-Brute Force-Backtracking- N Queens Problem, Hamiltonian Cycle, Branch and Bound-0/1 Knapsack Problem, Traveling Salesman Problem

MODULE V   ALGORITHM DESIGN TECHNIQUES II   9
Divide and Conquer-Strassen's Matrix Multiplication, Closest Pair of Points-Dynamic Programming – Longest Common Subsequence Problem, Subset Sum Problem- Greedy Approach- Huffman Coding - Job Sequencing with Deadlines Problem

 * Note : Algorithms will be taught in Sparks-like notation.

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

   CO1: Apply sorting algorithms and analyze their time complexity
   CO2: Choose appropriate searching algorithms and analyze their time complexity
   CO3: Apply hashing and various collision resolution techniques for a given application
   CO4: Illustrate various file organization and access methods
   CO5: Solve real world problems using various algorithmic design techniques such as branch and bound and backtracking
   CO6: Apply Dynamic programming, Divide and conquer and Greedy Algorithms to solve real world problems

                                                                                              TOTAL : 60 PERIODS

TEXT BOOKS:

1. Jean Paul Tremblay, Paul G. Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill, Second Edition, 2008. (Files,Sorting, Search Strategies)
2. Horowitz E., Sahni S., and Rajasekaran Sanguthevar, "Fundamental of Computer Algorithms", Universities Press (Computer Science), Second Edition, 2008. (Algorithms Design I)
3. Anany Levitin, "Introduction to the design and analysis of Algorithms", Pearson, Third edition, 2011(Algorithms Design II)

REFERENCES:

1. Alfred V. Aho, John. E. Hopcroft, Jeffrey D, Ullman, "Data Structures and Algorithms", Pearson Education, 2002.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3								3	2	3
2	3	3	3	3								3	2	3
3	2	2	2	2								2	2	3
4	2	1	1	1								2	1	2
5	3	3	3	3								2	1	3
6	3	3	3	3								2	1	3
Avg.	3	3	3	3								2	2	3

1-Low, 2-Medium, 3-High

COURSE CODE	COMPUTER NETWORK PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. Looking up internet address ,Implementation of port scanner ,Implementation of ping programming
2. Implementation of peer to peer communication using UDP
3. Implementation of socket program for UDP Echo Client and Echo Server
4. Implementation of Client Server Communication Using TCP
5. Implementation of Client server Application for chat
6. Concurrent server programming
7. Client server Communication using object stream, Client server Communication using byte stream
8. Implementation of File Transfer Protocol
9. Implementation of Sliding window protocol, Cyclic Redundancy Check
10. Message passing using Message Window - Broadcasting
11. Message Passing using Group Window - Multicasting
12. Implementation of Online test using Client Server Model

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO 1: Implement different models of servers using Socket functions.
CO 2: Simulate the working of protocols used in different layers of networks.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	3		3	3									3	3
2	3			3									3	3
AVG	3		3	3									3	3

1-Low, 2-Medium, 3-High

COURSE CODE	INTERNET TECHNOLOGY AND WEB SERVICES LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. Web page designing.
2. Web page designing using CSS, Frames, Filters etc.
3. Case studies like a trading system, a portal system, a reservation system etc., using Client and Server Side Technologies
4. Develop applications using XML.
5. Design web pages using the following frameworks:
   Servlets, Node.js
6. Accessing MongoDB from Node.js
7. Creating, Publishing, Testing and Describing simple Web services

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: Demonstrate an ability to develop web pages using CSS, Frames and filters.
CO2: Develop dynamic web pages using CGI concepts.
CO3: Design interactive web applications using XML parser (DOM, SAX).
CO4: Develop real time application using servlets and Node.js
CO5:.Create and publish Simple Web services

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12		
1	3		2		2									
2	3		2		2									
3	3		2		2									
4	3	3	3	3	3				2		3		3	2
5	3	3	3	3	3				2		2	1	3	2
AVG	3	3	3	3	3				2		2	1	3	2

1-Low, 2-Medium, 3-High

COURSE CODE	OPERATING SYSTEMS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. System calls - fork, exec, getpid, exit, wait, close, stat, opendir, readdir.
2. I/O system calls -open, close, read, write, create, lseek, dup.
3. Simulate UNIX commands - ls, grep, chmod, passwd, who, date.
4. Shell programming.
    - Simple functions.
    - Basic tests.
    - Loops.
    - Patterns.
    - Expansions.
    - Substitutions.
5. Process Scheduling- FCFS, SJF, Priority and Round robin.
6. Synchronization using semaphores
7. Implementation of Inter-process Communication.
8. Implementation of memory management schemes –first fit, Best fit, worst fit and page replacement algorithms

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able

CO1: Demonstrate different system and I/O calls in operating systems
CO2: Develop programs using UNIX commands and shell programming.
CO3: Demonstrate algorithms for process scheduling, process synchronization, Inter-process communication and memory management.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2											
2	3	3	3	3									2	
3	3	3	3	3									2	
AVG	3	3	3	3									2	

1-Low, 2-Medium, 3-High

COURSE CODE	STATISTICS FOR DATA SCIENCE AND DATA MINING	L	T	P	C
		3	1	0	4

MODULE I   SUMMARIZING DATA   9

Introduction-Need for Statistics - Descriptive and Inferential Statistics- Describing data with averages- Describing Variability - Normal Distribution and Standard (z) scores-Relationships among Data: Correlation- Regression.

MODULE II   INFERENTIAL STATISTICS   9

Introduction to Hypothesis Testing (Z test)-Need for hypothesis testing - Confidence Intervals - t Test for one sample - One factor Analysis of Variance- Two sources of variability - f test-One variable chi-square test- two variable- chi-square test.

MODULE III   DATA WAREHOUSE, DATA MINING AND DATA PREPROCESSING   9

Data Warehouse: Basic concepts, Data Cube and OLAP - Data Mining-Kind of Data-Data Patterns- - Targeted Applications - Major Issues in Data Mining. Data Pre-processing: Major tasks in data pre-processing - Data Cleaning- Data Integration - Data Reduction: Attribute subset selection - Data Transformation by normalization

MODULE IV   ASSOCIATION RULE MINING AND CLUSTERING   10

Definition-Apriori Algorithm -FP Tree Algorithm-Improving the Efficiency of Apriori-Border Algorithm-Generation of Association Rules
Cluster analysis - Types of data -Requirements for cluster analysis - Categorization of major clustering methods - Partitioning K-Means and K-Medoid algorithm - Hierarchical clustering - BIRCH - Density based cluste

MODULE V   CLASSIFICATION   8

Classification: Decision tree induction - Attribute selection measures - Tree Pruning – Bayesian Classification: Bayes Theorem – Naïve Bayesian Classification-Support Vector Machine – Linearly Separable and Linearly Non-Separable

COURSE OUTCOMES

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

CO1: Use statistical techniques to characterize and summarize the given data.

CO2: Evaluate the given data using various statistical tests such as Z-test, t-test, f-test and chi square tests.

CO3: Apply appropriate data pre-processing techniques for the given data.

CO4:Apply association rules mining techniques to perform frequent pattern mining.

CO5: Design clustering models for unsupervised learning problems.

CO6: Design classification models to perform classification for real world data.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Robert S.Witte, John S.Witte, " Statistics", Eleventh Edition, - Wiley Publications, 2017(For Data Summarization and Inferential Statistics)
2. Jiawei Han &Micheline Kamber, "Data Mining-Concepts and Techniques" Morgan Kaufmann Publishers, Fourth Edition, 2022.

REFERENCES:

1. Dunham, "Data Mining- Introductory and Advanced Topics", Pearson Education, New Delhi, First Edition, 2006.
2. Pieter Adriaans, DolfZantinge, "Data Mining ", Pearson Education, Delhi,Third Edition, 2009. 3. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World ", Pearson Education,Seventhindian Reprint New Delhi,2003.
3. George M. Marakas, " Modern Data Warehousing, Mining, & Visualization Core concepts", Pearson Education, First Edition, 2003
4. PaulrajPonnaiah, "Data Warehousing Fundamentals", Wiley Publishers, Singapore, First Edition, 2001.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2										3	1	3
2	3	2										3	1	3
3	2	3	3	2	2							3	2	3
4	2	2	3	3	3							3	2	3
5	2	2	3	3	3							3	2	3
6	2	2	3	3	3							3	2	3
Avg.	2	2	3	3	3							3	2	3

1-Low, 2-Medium, 3-High

COURSE CODE	PRINCIPLES OF SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

The Software Engineering Discipline - Software Development Projects - Software Life Cycle Models: Use of Life Cycle Models - Classical Waterfall Model-Iterative Waterfall Model-Prototype model-Evolutionary Model-Spiral Model.

MODULE II   SOFTWARE REQUIREMENTS AND ANALYSIS   8

Requirements Analysis and Specification - Requirements Gathering and Analysis- Value of good SRS – Requirement process- Requirement Specification – desirable characteristics, components and Structure of requirements document – Functional Specification with use cases – basics - Developing Use Cases -DFDs - Data Dictionary - ER Diagrams.

MODULE III SOFTWARE DESIGN   10

Design concepts - Cohesion and Coupling- The Open-Closed Principle - Function Oriented Software Design: Structured charts – Structured design methodology - Detailed Design: Logic / Algorithm design – State Modeling of Classes.

MODULE IV   CODING   7

Programming principles and guidelines – Structured programming – Information hiding – some programming practices - Coding standards - Code inspection – Planning- Self review - Group review meeting.

MODULE V   TESTING   11

Testing Fundamentals –Black Box Testing: Equivalence Class Partitioning – Boundary Value Analysis - White box Testing: Control Flow based criteria – Data Flow based Testing - Levels of Testing: Unit Testing - Integration Testing - System Testing – Acceptance Testing.

COURSE OUTCOMES

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

CO1: Choose an appropriate software life cycle model for a given application.
CO2: Identify the functional requirements, prepare data flow, ER diagrams and Software Requirement Specifications.
CO3: Apply suitable architectural styles and software design methodologies for real world problems.
CO4: Make use of coding standards and practices in developing practical applications.
CO5: Plan and inspect the developed software by conducting review meetings.
CO6: Design suitable test cases for software systems using various testing techniques.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Pankaj Jalote, "Software Engineering A Precise Approach", Wiley India, Third edition 2012.
2. Rajib Mall, "Fundamentals of Software Engineering", PHI Learning Private Limited, Fourth Edition 2014. (Introduction only)

REFERENCES:
1. Roger.S.Pressman, Bruce R. Maxim, "Software Engineering A Practitioner's Approach", McGraw Hill International Edition, Eighth Edition, 2015.
2. Ian Sommerville, "Software Engineering", Dorling Kindersley (India) Private Ltd., Ninth Edition, 2011.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3		2						2	3		2	
2	3	3	3	2						2	3	2	2	
3	3	3	3	3	2					2	3	2	2	
4	3	3	3	2	2					3	3	2	3	
5	2	2	3	2	2				2	2	2	2	2	
6	3	2	3	2	2				2	2	2	2	3	
Avg.	3	3	3	2	2				3	2	3	2	2	

1-Low, 2-Medium, 3-High

COURSE CODE	EMBEDDED SYSTEMS AND IoT	L	T	P	C
		3	0	0	3

MODULE I   ARM PROCESSOR   9
Introduction to Embedded Systems –Background of ARM and ARM Architecture - Registers – Special Registers – Operation mode – Stack memory operations - 5 Stage pipeline organization – ARM Instruction List- ARM instruction execution – Memory Map.

MODULE II   EXCEPTION AND INTERRUPTS   9
Reset types and reset signals-Exception types-vector tables – Fault exceptions – Nested Vector Interrupt Controller overview- Basic interrupt configuration – SYSTICK timer – Interrupt behaviour : Sequence interrupt latency – Faults related to interrupts

MODULE III   BASICS OF IOT & MACHINE TO MACHINE   9
Physical design of IoT - Logical design of IoT – Enabling Technologies – IoT Levels –Domain specific IoT (Principle only) use cases – Introduction to IoT and M2M - SDN and NFV for IoT - IoT systems Management with NETCONF-YAN - IoT Design Methodology.

MODULE IV   IOT PHYSICAL DEVICES – ARDUINO AND RASPBERRY PI   9
Basic Building Blocks – Arduino – Raspberry Pi - About the Board – Linux on Raspberry Pi -Interfaces-Programming Raspberry Pi with Python - IoT Devices : pcDuino – BeagleBoneBlack –CubieBoard - Introduction to Cloud Storage model and Communication APIs.

MODULE V   DATA ANALYTICS FOR IOT AND USECASES   9
Introduction – Apache Hadoop - Using Hadoop MapReduce for Batch data Analytics – Apache Spark- IoT UseCases – Agriculture – Home Automation - Smart City – Smart Grid - Building Automation – Structural Monitoring - Health Care- Case study: Data Analytics Tools

   COURSE OUTCOMES
 At the end of the course, students will be able to
   CO1: Explain the architecture of ARM Processor
   CO2:Construct program, verify, analyze and troubleshoot ARM assembly and C language programs.
   CO3: Describe the Exceptions and interrupt mechanisms of ARM Processor.
   CO4:Assess technologies such as M2M , SDN, NFV with IoT and IoT system management.
   CO5: Develop Applications using Physical devices such as Arduino and Raspberry
   CO6: Apply Data Analytics for IoT and IoT use cases in specific domains.

                                                                                    TOTAL : 45 PERIODS

TEXT BOOKS:

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", 2nd Edition, Newnes, (Elsevier), 2010.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands –on approach", Universities Press, 2017.

REFERENCES:

1. Steve Furber, ARM System-on-Chip Architecture, Second Edition,Pearson, 2015.
2. Adrian Mcewn, Hakin Cassimally, "Designing the Internet of Things", Wiley Publications, 2015.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		2									2	2	2
2	3	3	3	2	2						1	2	2	
3	3	1	2	1									1	1
4	3	2	2	1	1	1			2	1	1	1	2	2
5	3	3	2	2	2	1	1		1	1		1	2	1
6					3				2		2		2	1
Avg.	3	2	2	1	2	1	1		2	1	1	2	2	1

1-Low, 2-Medium, 3-High

COURSE CODE	EMBEDDED SYSTEMS AND IOT LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

Embedded Systems
1. ARM Programming
2. Matrix Keyboard
3. LCD Display
4. Buzzer and Relay
5. Assembly Language Programming using Keil IDE.
6. Digital Circuit Development using FPGA.
7. PIC Microcontroller based Application.
8. Programming Robots.

Internet of Things
1. Arduino Programming
2. Smart Dustbin
3. Publish and Subscribe using MQTT Communication Protocol.
4. Raspberry Pi
5. AWS IoT with Raspberry Pi
6. Luminosity Logger
7. IoT Data Logging using ThingSpeak.
8. Sending and Receiving Call/SMS using SIM 800L GPRS Module.
9. Master Slave Communication using HC-05 Bluetooth Module.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able

CO1: Develop simple Assembly language Programs.
CO2: Develop applications based on IoT and Sensors.
CO3: Develop Embedded C Programs.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	2					2		2	2	2	
2	3	3	3	3	2		2		2		2	1	2	1
3	3	2	3	3					2		2		2	
AVG	3	3	3	3	2		2		2		2	2	2	1

1-Low, 2-Medium, 3-High

COURSE CODE	DATA MINING LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. Plotting functions: Normal curves, Density and contour plots, Correlation and scatter plots, Histogram, Three Dimensional Plotting.
2. Data Pre-processing.
3. Feature Extraction Algorithms.
4. Regression Algorithms.
5. Classification Algorithms.
6. Clustering Algorithms.
7. Deployment of ML models.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: Demonstrate charts and graphs using Python/R.

CO2: Apply suitable classification /clustering techniques for a given problem using Python/R.

CO3: Deploy a machine learning model using Python/R for a given problem.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	3	3							3	2	3
2	2	3	3	3	3							3	2	3
3	2	3	3	3	3							3	2	3
AVG	2	3	3	3	3							3	2	3

1-Low, 2-Medium, 3-High

COURSE CODE	OPEN SOURCE SYSTEMS LABORATORY	L T P C
		0 0 2 1

LIST OF EXPERIMENTS:

1. Demonstration of Open source software installation i.e. xampp, lamp, etc.
2. Simple Programs in PHP.
3. PHP with MySQL Connectivity
4. Simple Programs in Python.
5. Python Programming with MySQL Connectivity
6. Demonstrate CURD operation for various NoSQL databases:
    *   Document Database
    *   Column Family Database
    *   Key Value Database
    *   Graph Database
7. Using MongoDB, Cassandra,Redis,Neo4j etc.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able

CO1: Illustrate the installation of various packages in open source operating systems
CO2: Demonstrate practical application in software development using open source tools like Python, PHP and MySQL
CO3: Develop practical application on various NoSQL databases

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	3								3	2	2
2	3	3	3	3								3	2	2
3	3	3	3	3								3	2	2
AVG	3	3	3	3								3	2	2

1-Low, 2-Medium, 3-High

COURSE CODE	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9
Foundation of AI - Agents and Environments- Concept of Rationality - Nature of Environments - Structure of Agents-Problem- Solving Agents and examples-Uninformed Search Strategies-Searching with Partial Information.

MODULE II   SEARCH TECHNIQUES   9
Search Strategies: A* Search -Heuristic Functions -Local Search Algorithms and Optimization Problems -Constraint Satisfaction Problems -Backtracking Search for CSPs - Local Search for Constraint Satisfaction Problems - Structure of Problems - Games- Optimal Decisions in Games - Alpha-Beta Pruning.

MODULE III   KNOWLEDGE AND REASONING   8
Logic -Propositional Logic - Syntax and Semantics of First-Order Logic - Using First-Order Logic - Knowledge Engineering in First-Order Logic - Propositional vs. First-Order Inference - Forward Chaining -Backward - Chaining -Resolution

MODULE IV   UNCERTAIN KNOWLEDGE AND REASONING   9
Acting under uncertainty - Bayes' rule and Its use - Representing Knowledge in an Uncertain Domain -The Semantics of Bayesian Networks - Exact Inference in Bayesian Network - Approximate Inference in Bayesian Networks - Hidden Markov Models

MODULE V   LEARNING   10
Forms of Learning - Artificial Neural Networks-Ensemble Learning-Logical Formulation of Learning-Knowledge in Learning - Explanation -Based Learning -Learning Using Relevance Information - Inductive Logic Programming - Statistical Learning -Learning with Complete Data - Passive Reinforcement Learning-Active Reinforcement Learning

COURSE OUTCOMES
At the end of the course, students will be able to
  CO1 : Illustrate real world problems from the perspective of intelligent agents to achieve problem oriented goals.
  CO2 : Apply various informed and uninformed search strategies in optimal decision making.
  CO3: Design solution for constraint satisfaction problems and adversarial search problems.
  CO4 : Apply propositional Logic and first order logic for building a knowledge base to infer reasoning using knowledge Engineering.
  CO5 : Describe representation of uncertain knowledge, Bayesian Networks and Temporal models.
  CO6 : Describe various learning algorithms to improve the performance of intelligent agents.

                                                                   TOTAL : 45 PERIODS

TEXT BOOKS:

1. Stuart J Russell and Peter Norvig, "Artificial Intelligence- A Modern Approach", Pearson Education Series, Fourth Edition, 2020

REFERENCES:

1. Deepak Khemani, "A First Course in Artificial Intelligence", Mc Graw Hill Education, First Edition, 2014.
2. Dan W. Patterson "Introduction to AI and ES", Pearson Education, First Edition, 2007
3. Patrick Henry Winston, "Artificial Intelligence", Addison Wesley publishers, Third Edition, 1992.
4. Elaine Rich, Kevin Knight and Shivashankar, "Artificial Intelligence", McGraw Hill, Third Edition, 2017

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2										3	2	2
2	3	3	2	2	3							3	2	2
3	3	3	3	2	3							3	2	2
4	3	3	2	2	2							3	2	2
5	3	3	2	2	2							3	2	2
6	3	3	3	3	3							3	2	2
Avg.	3	3	2	2	3							3	2	2

1-Low, 2-Medium, 3-High

COURSE CODE	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   12
Computer and Network Security Concepts: Security Attacks - Security Services - Security Mechanisms. Introduction to number theory: Fermat's and Euler's theorems - Testing on Primality: miller rabin primality test. Modular arithmetic-Euclidean Algorithm.
Classical Encryption Techniques: Symmetric Cipher Model - Substitution Techniques: Playfair cipher, vigenere cipher– Transposition Techniques: Columnar Transposition. Block
Cipher and the Data Encryption Standard- Advanced Encryption Standard-Block Cipher
Operation: Cipher block Chaining mode - Output feedback mode-Counter mode.

MODULE II   ASYMMETRIC CIPHERS   7
Public Key Cryptography and RSA: Principles of Public key Cryptosystems - RSA Algorithm - Diffie-Hellman Key Exchange - Elliptic Curve Arithmetic - Elliptic Curve Cryptography.

MODULE III   CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS   8
Cryptographic   hash   functions: Applications-Requirements   and   Security-Secure   Hash AlgorithmSHA-3.Message Authentication Codes : Requirements – Functions. Digital Signatures: Digital Signatures-NIST Digital Signature Algorithm- Elliptic Curve Digital Signature Algorithm.

MODULE IV   MUTUAL TRUST AND NETWORK SECURITY   12
Key Management and Distribution: Distribution of public keys-X.509 Certificates- Public-Key Infrastructure. User Authentication: Kerberos. Transport Layer security: Transport Layer security– Secure Shell (SSH).Electronic Mail Security : Pretty Good Privacy-S/MIME. IP Security: Policy- Encapsulating Security Payload - Cryptographic primitives in block chain.

MODULE V   INTRUSION DETECTION SYSTEM   6
Intruders - Intrusion detection - Malicious Software : Viruses and Related Threats – Virus Countermeasures - Distributed DoS attacks. Firewalls : Firewall Design Principles.

 COURSE OUTCOMES
 At the end of the course, students will be able to
  CO1 : Apply the symmetric and asymmetric ciphering algorithms for security attacks
  and threats.
  CO2 : Apply modern algebra and number theory to understand cryptographic
  algorithms and vulnerabilities.
  CO3 : Illustrate hashing and message authentication concepts based on mathematical
  terminology associated with it.
  CO4 : Apply the concepts of key management and user authentication techniques.
  CO5 : Describe various protocols for network security to protect against the threats
  in the networks.
  CO6 : Describe various Intrusion detection techniques in network systems.

                                                                      TOTAL : 45 PERIODS

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall of India, Eight Edition, 2022.
2. William Stallings, "Cryptography and Network Security - Principles and Practices", Prentice Hall of India, Fourth Edition, 2005.(Intrusion Detection System)

REFERENCES:

1. *Behrouz A.Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata McGraw Hill, Third Edition, 2015.*
2. *Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, Third Edition, 2013.*
3. *Wade Trappe, Lawrence C.Washington, "Introduction to Cryptography with coding theory", Pearson education, Second Edition, 2011.*
4. *Bruce Schneier, "Applied Cryptography", John Wiley and Sons, New York, Second Edition, 2006*

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3		3	3	3								3	3	
2	3			3									3	3	
3	3			3									3	3	
4	3		3	3	3								3	3	
5	3			3									3	3	
6	3		3	3	3								3	3	
Avg.	3		3	3	3								3	3	

1-Low, 2-Medium, 3-High

COURSE CODE	MACHINE LEARNING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   **9**

Introduction-Learning Tasks-Stages-Scenarios-PAC Learning Model - Generalities - Deterministic vs Stochastic scenarios - Bayes Error and Noise - VC Dimension - Model Selection - Estimation and Approximation Errors - Empirical Risk Minimization - Structural Risk Minimization - Cross Validation - n-Fold Cross Validation

MODULE II   PROBABILISTIC AND GRAPHICAL MODELS   **9**

Discriminant Functions - Two Classes - Multiple Classes - Least Squares Classification - Fisher's Linear Discriminant - Probabilistic Generative Model - Maximum Likelihood Solution- Probabilistic Discriminative Model - Logistic Regression-Bayesian Networks

MODULE III   NEURAL NETWORKS AND KERNEL METHODS   **9**

Feed forward Network Functions - Network Training - Error Back Propagation - Regularization in Neural Networks - Radial Basis Function Networks - Maximum Margin Classifiers - Overlapping Class Distributions - Multiclass SVMs - SVMs for regression

MODULE IV   CLUSTERING AND ADVANCED LEARNING METHODS   **9**

K-Means Clustering-Mixtures of Gaussians - EM Algorithm - AdaBoost - Online LearningPrediction with Expert Advice - Mistake Bounds and Halving Algorithm - Weighted Majority Algorithm - Exponential Weighted Average Algorithm - Winnow Algorithm

MODULE V   REINFORCEMENT LEARNING   **9**

Learning Scenario-Markov Decision Process Model-Policy-Planning Algorithms-Value IterationPolicy Iteration-Linear Programming-Stochastic Optimization-TD(0) algorithm-Q-Learning Algorithm-SARSA -TD(λ) Algorithm - Large State Space

COURSE OUTCOMES

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

CO1: Evaluate the challenges and parameters for model selection in machine learning.

CO2: Apply various probabilistic and graphical models to solve real world problems.

CO3: Design machine learning models using Neural Networks and Support Vector Machines

CO4: Apply clustering algorithms for solving real world problems

CO5: Develop machine learning models for online learning.

CO6: Apply reinforcement algorithms and its usage in various applications

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.
2. Christopher M Bishop, "Pattern Recognition and Machine Learning Learning", Springer, 2011.

REFERENCES:

1. *E*them Alpaydin,"Introduction to Machine Learning‖, MIT Press, Prentice Hall of India, Third Edition 2014.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997
3. Trevor Hastie, Robert Tibshirani, Jerome friedman , "The Elements of Statistical learning", 2nd Edition, Springer,2017

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2	2	2								3	1	3
2	2	2	3	3	2							3	1	3
3	2	2	3	3	2							3	1	3
4	2	2	3	3	2							3	1	3
5	2	2	3	3	3							3	1	3
6	2	2	3	3	3							3	1	3
Avg.	2	2	3	2	2							3	1	3

1-Low, 2-Medium, 3-High

COURSE CODE	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Chatbot Application
2. Uninformed Search strategies
3. Informed Search strategies
4. Local Search Algorithms
5. Adversarial Search
6. Knowledge representation and inference
7. Reasoning with uncertainty
8. Applications of Machine Learning Algorithms

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1 : Apply suitable informed, uninformed and adversarial search strategies for problem solving.
CO2 : Apply using logic based techniques to perform inference for various real life problem domains.
CO3 : Develop machine learning models for Data inference and prediction

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	3	2								3	1	3
2	1	3	3	3	3							3	1	3
3	1	3	3	2	3							3	1	3
AVG	3	3	3	3	3							3	1	3

1-Low, 2-Medium, 3-High

COURSE CODE	DATA VISUALIZATION LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. **Building Blocks of Data Visualization** : Dimensions and Measures – Measures Names and Values – Working with Time Series Data – Aggregation and Granularity – Aggregation Options – Marks cards and Level of Detail – Custom Shapes – Filtering Data- Pages Shelf.
2. **Tableau Basic Visualization**: Highlight Table – Bar in bar – Histogram – Pie Charts- Tree Map – Bubble Chart – Lines Chart – Area Chart – Heat Map.
3. **Formatting in Tableau :** Theme and Workbook Level Formatting – Axis Lines and Formatting – Parts of the View – Number Format – Titles and Captions- Mark Labels – Styling and Customizing a Tool Tip – Visualization in Tool Tip – Editing Axis – Annotating the Viz.
4. **Data Preparations:** Managing Meta Data and Data Types – Data Extraction – Data Preparation and Cleaning – Wide and Long Formats – Filtering of Rows using Data Source Filters – Joins – Joining Multiple Fields – Complex Joins – Data Blending – Data Union.
5. **Slicing and Dicing Data in Tableau:** Sorting – Hierarchy – Groups – Sets – Data Filters – Advanced Filtering.
6. **Table Calculations:** Table Functions – Window Functions- Conditional Highlighting using Window Functions – Moving Calculations- Rank Functions – Running Functions -
   Secondary Calculations with Pareto Chart
7. **Level of Detail Expression :** FIXED - Level of Detail Expression – Fixing Duplicate Records in Tableau using FIXED – INCLUDE LOD Expression – EXCLUDE LOD Expression – Table Scoped Level of Detail Expression – Nested LOD
8. **Tableau Functions:** Types of Calculations – The Number Functions – The String Functions – Type Conversions – The Date Functions- Datetrunc and Datepart – Gantt Charts using Date functions – The Logical functions – Calculations using Sets- Aggregate Functions – Attribute Function.
9. **Tableau Dashboards:** The Story Telling – Dashboard – Containers – Dashboard Actions.
10. **Case Studies:** Tracking Consumer Complaints and Analyzing Spotify Music Classification using Tableau.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able
  CO1: Develop charts and graphs using Tableau for a given problem.
  CO2: Apply suitable table calculation techniques for data transformation.
  CO3: Design a dashboard using Tableau for Business Intelligence**.**

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	3	3							3	3	3
2	1	2	2	3	3							3	3	3
3	1	2	2	3	3							3	3	3
AVG	1	2	2	3	3							3	3	3

1-Low, 2-Medium, 3-High

COURSE CODE	MOBILE APPLICATION DEVELOPMENT LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Study of Android architecture and Mobile Application Development Framework.
2. Mobile Application Design using GUI components and layouts
3. Event Handling in Mobile Applications
4. Mobile Application Development with databases such as sqlite
5. Accessing other applications in the device such as SMS
6. File Handling to manipulate data in SD Card
7. Mobile applications utilizing GPS location information
8. Mobile Applications to create alert messages, setting notifications/alarms etc.
9. Communication with internet applications/network communications

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1 : Illustrate the structure of mobile application development framework for android OS.

CO2 : Design mobile applications using suitable GUI components.

CO3 : Develop mobile applications for real world applications using the appropriate interfaces available on mobile devices.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3		3				3				3	3
2	3		3						3				3	3
3	3		3		3				3				3	3
AVG	3		3		3				3				3	3

1-Low, 2-Medium, 3-High

COURSE CODE	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1 : Apply computing algorithms and techniques in designing simple solutions and examine the outcome of real- time projects.

CO2 : Integrate various interdisciplinary areas to enhance domain knowledge.

CO3 : Develop technical skills in providing feasible solutions for real-life problems and enhance technical writing ability.

CO4 : Demonstrate effective communication and collaborative working in peer groups.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	3	3	3	3	2	3		2	3	3	3
2	2	3	3	3	3	3	3	2	3		2	3	3	3
3	2	3	3	3	3	3	3	2	3		2	3	3	3
4										3	2	3		
AVG	2	3	3	3	3	3	3	2	3	3	2	2	3	3

1-Low, 2-Medium, 3-High

COURSE CODE	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

Introduction-Types of Analytics-Characteristics-Applications-Analytics Flow for Big Data-Big Data Stack-Mapping Analytics Flow to Big Data Stack. Big Data Patterns- Analytics Architecture Components and Design Styles

MODULE II   HADOOP AND MAP REDUCE   9

Introduction to Hadoop-Hadoop and its Ecosystem-Hadoop Distributed File System-Map Reduce Framework and Programming Model-Hadoop Yarn.
Map Reduce: Map Tasks-Key-Value Pair-Grouping by Key-Partitioning-Reduce Tasks-Map Reduce Processing Steps-Composing Map Reduce for Calculations-Matrix-Vector Multiplication.

MODULE III   HIVE AND PIG   9

Hive Architecture-Hive Installation-Comparison with RDBMS-Hive Data Formats and File Formats-Hive Data Model-Hive Integration and Workflow-HiveQL: DDL- DML- Querying-Aggregation-Join-Group By Clause. Pig: Architecture-Data Model-Pig Latin Scripts.

MODULE IV   DATA STREAM MINING   9

Data Stream Concepts-Data Stream Model-Architecture-Stream Queries-Stream Processing Issues-Stream Computing-Sampling Data in a Stream-Filtering of Stream-Counting Distinct Elements in a Stream-Counting of ones in a window-Decaying Windows.

MODULE V   APPLICATIONS OF BIG DATA ANALYTICS   9

Recommendation System: Collaborative – Recommendation System Model-Content Based – Knowledge Based- Hybrid. Social Networks: Social Networks as Graphs-Topological Analysis using Centralities and Page Rank-Analysis using K-Core and Neighborhood Metrics - SimRank.

COURSE OUTCOMES

At the end of the course, students will be able to
CO1: Explain fundamental characteristics of Big Data analytics and its applications.
CO2: Explain Hadoop Ecosystem and Programming Model
CO3: Apply Hadoop Map Reduce Framework for solving computational problems.
CO4: Demonstrate the usage of HIVE and PIG for real world problems.
CO5: Illustrate the solutions for Data Stream processing.
CO6: Describe the usage of Big Data Analytics in Recommender Systems and Social Networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018.

2. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine Learning", McGraw Hill Education, 2018

REFERENCES:

1. Tom White, "Hadoop: The Definitive Guide", O`Reilly Publishers, USA, Fourth Edition, 2015.
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, Second Edition, 2016.
3. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, Second Edition, 2019.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2										3		3
2	3	3			2							3		3
3	2	3	3	3	3							3		3
4	2	3	3	3	3							3		3
5	2	3	3	3	3							3		3
6	2	3	3	3	3							3		3
Avg.	2	3	3	3	3							3		3

1-Low, 2-Medium, 3-High

COURSE CODE	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO SYSTEMS AND EMBEDDED COMPUTING SYSTEMS   9

Study of Systems – Standard Forms of System Description – Controllability, Observability and Identifiability- Analytical Solutions of Linear system Models –Steady state Errors of Systems – Case study in Systems Stability Analysis – Embedded Computing Systems – Hardware Architectures of Embedded Computing Systems- Design Metrics- Embedded Control Systems- Hardware- Software Co design – Case study: FPGA based CPU Core.

MODULE II INTRODUCTION TO CYBER PHYSICAL SYSTEMS AND INTERNET OF THINGS   9

Cyber Physical Systems – Cyber Physical Systems Design Recommendations- Cyber Physical System requirements - Cyber Physical System Applications – Smart Cities and the Internet of everything – Case study: Cyber Physical Vehicle Tracking System- The Internet of things – Radio Frequency Identification Technology- Wireless Sensor Networks Technology- Powerline Communication – RFID Applications – Case study: Luggage Tracking System.

MODULE III   UBIQUITOUS COMPUTING   9

Ubiquitous Computing History to Date - Ubiquitous Computing Fundamentals – Smart Devices: Components and services – Tagging, Sensing and Controlling – Autonomous Systems in Ubiquitous Computing – Case study: Robot Manipulator – Introduction to Systems Engineering.

MODULE IV   CHARACTERIZATION, ADAPTIVE CONTROL, OPTIMIZATION OF PHYSICAL SYSTEMS 9

Introduction – CPS Characterization – Analysis of Representative CPS Domains – Recommendations based on a Cross Domain Analysis – Communication Channel of Multiagent Systems – Consensus Control – Interaction of Control Theory and information Theory – Cross Layer Design Resource Allocation of Distributed Control – A Control and Optimization Framework for CPS as Hybrid Systems.

MODULE V   SECURITY AND PRIVACY IN CYBER PHYSICAL SYSTEMS   9

Introduction – Defining Security and Privacy – Defining Cyber Physical Systems- examples of security and Privacy in action – Security and Privacy Issues in CPS – Local Network Security for CPS – Internet Wide Secure Communication – Security and Privacy for Cloud Interconnected CPS.

COURSE OUTCOMES

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

   CO1: Explain the foundations of System Models and Embedded Computing Systems.

   CO2: Assess the Design recommendations, Applications of CPS along with the role of IoT in various wireless technologies.

   CO3: Describe the preliminary principles and the devices used in CPS.

   CO4: Illustrate the Adaptive Control and Energy Harvesting in Cyber Physical Systems.

   CO5: Analyze the overall specifications of CPS and translate it to the different subsystems design requirements.

   CO6: Outline the need of Security and Privacy in CPS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dietmar P.F. Möller, "Guide to Computing Fundamentals in Cyber Physical Systems: Concepts, Design Methods and Applications", Springer, First Edition, 2016.

2. Houbing Song, Danda B Rawat, Sabina Jeschke, "Cyber Physical Systems: Foundations, Principles and Applications" , Elsevier Science, First Edition, 2017.

3. Houbing Song, Glenn A. Fink, Sabina Jeschke, "Security and Privacy in Cyber Physical Systems: Foundations, Principles and Applications", Wiley, First Edition, 2017

REFERENCES:

1. Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems", Addison-Wesley, 2017.
2. P. Venkata Krishna, V. Saritha, H. P. Sultana, "Challenges, Opportunities and Dimensions of Cyber Physical systems", IGI Global, First Edition, 2014.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		1		1							1	2	
2	3	1	2		1	1			1				2	1
3	2	1	2		1				1				1	1
4	2	1	1										2	1
5	2	2	1										2	1
6	2	1	1		1	1		1			1		2	1
Avg.	3	1	1		1	1		1	1		1	1	2	1

1-Low, 2-Medium, 3-High

COURSE CODE	FULL STACK DEVELOPMENT	L	T	P	C
		3	1	0	4

MODULE I INTRODUCTION   9

Raise of Web, Mobile Web, HTML State, Application Vs Websites, Work plan: Identify the requirements, Define the work, Track the work, Kanban, Continuous Improvement, Prioritization & Estimation, Managing Bugs, Continuous Delivery, User Experience: Information Architecture, user experience right and Polish, Implementing user experience.

MODULE II DESIGN SYSTEM   9

System Architecture, Identify user interactions, Handling Commonalities, Working with legacy and external dependencies, Component interactions, Applications Vs Modules, cross-functional requirements, caching, Designing of failure, Design Modules, Refactoring, tools, changing the architecture.

MODULE III   TESTING & ACCESSIBILITY   9

Test-Driven Development, Test Pyramid, Behavior-Driven Development, Three Amigos, Manual Testing, Visual Testing, Cross-Functional Testing, Accessible from the start, Working with Assistive Technologies, Dealing with Interactive UI, Testing for Accessibility, Avoiding Common Mistakes.

MODULE IV   APIs AND STORING DATA   9

API Responsibilities, Designing REST API, Securing API, Event-Based APIs, Discovering APIs, Using APIs, Jenkins Pipeline flow, Types of Databases, SQL or NoSQL, store data, Access data from App, Manage the data, Protect the Data.

MODULE V   SECURITY AND DEPLOYMENT   9

Trust and Secrets, Responding to incidents, The Golden Rule, Threats, Security Checklists: Injection-Broken Authentication and Session Management- Cross-Site Scripting (XSS) -Insecure Misconfiguration-Sensitive Data Exposure- Missing Functional Level Access Control, Cross-site Request Forgery(CSRF), Two Factor App, Gitlab.

COURSE OUTCOMES

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

CO1: Develop a work plan including the requirements, workflow, delivery management and user experience.

CO2: Design the system considering various interactions and dependencies

CO3: Demonstrate various testing methodologies required for the application.

CO4: Illustrate the working of the APIs required for Full Stack Development

CO5: Apply intermediate and advanced web development practices and Create visualizations in accordance with UI/UX theories.

CO6: Outline the security threats and security policies in deploying Full stack application

TEXT BOOKS:

1. Chris Northwood, "The Full Stack Developer – Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer", APress,2018.

2. David Choi, "Full-Stack React, TypeScript and Node", Packt, 2020.

REFERENCES:

1.   Steve Fulton and Jeff Fulton, "HTML5 Canvas", O'Reilly, 2013
2.   Marijin Haverbeke, "Eloquent JavaScript – A Modern Introduction to Programming",No scratch Press,2018
3.   Addy Osamani, "Learning JavaScript Design Patterns", O'Reilly, 2012

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		3		3								3	2
2	3		3		3								3	3
3	3		3	3									3	3
4	3		3	3	3								3	3
5	3		3		3								3	3
6	3		3	3		3							2	2
Avg.	3		3	3	3	3							3	3

1-Low, 2-Medium, 3-High

COURSE CODE	FULL STACK DEVELOPMENT LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Basic HTML Tags and Elements.
2. Familiarize with JS, and CSS, Animation using sample webpage
3. Design a Webpage using advance HTML Form tags input–date, time, number, email, HTML5 Header And Footer, spell check and editable areas.
4. Design a Web Page Demonstrating Drag and Drop Functionality. Implement program demonstrating Local Storage and session storage.
5. Design a Webpage using Basic CSS Tags. Demonstrate Inline, Internal and External Style sheets using advanced CSS.
6. Design program to demonstrate Event Handling using Java Script.(Minimum 3 Events)
7. Design a Form using HTML and CSS and integrate with the Database using PHP.
8. Get details from a webpage and display it in PHP pages
9. Change a Content of webpage Operations using JQUERY Selectors / using AJAX.
10. Mini Project

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: Apply advanced web development practices using HTML/CSS and JavaScript.
CO2: Develop a fully functioning website and deploy on a web server.
CO3: Create visualizations in accordance with UI/UX theories..
CO4: Implement a JQuery backend API for storing and retrieving data via AJAX calls.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3		3								3	3
2	3		3		3								3	3
3	3		3		3				3				3	3
4	3		3		3				3				3	3
AVG	3		3		3				3				3	3

1-Low, 2-Medium, 3-High

COURSE CODE	BIG DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS:

1. MapReduce application for word counting on Hadoop cluster
2. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.
3. K-means clustering using map reduce Understand data pipeline using Pig
4. Develop Pig Scripts and call UDF's to accomplish functionalities to meet the problem objectives
5. Embedding PIG Latin in Python
6. Log analysis using "Pig" on semi structured data
7. Perform query processing on data warehousing after successful installation of "Hive"
8. Perform adhoc query on HDFS data using Hive Query Language (HQL)
9. Accomplish MapReduce Job by using Hadoop Streaming API

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Solve the Big Data problems using Map Reduce Technique.
CO2: Design algorithms that use Map Reduce Technique to apply on Unstructured and structured data.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	POS	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	3	3							3		3
2	2	3	3	3	3							3		3
AVG	2	3	3	3	3							3		3

1-Low, 2-Medium, 3-High

COURSE CODE	DEVOPS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Installation of Git and work on local and remote git repositories.
2. Fetch and synchronize Git repositories.
3. Perform basic branching and merging in Git.
4. Install Jenkins, configure a build job in Jenkins and manage the version control using Git.
5. Create CI/CD pipeline in Jenkins.
6. Install Docker and execute basic commands in Docker.
7. Creating containers of different Operating System Images from Docker file.
8. Deploy and manage java/web application on Docker.
9. Perform continuous testing of application.
10. Install and Configure software application using Chef/Puppet/Ansible/ Saltstack.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1: Outline the importance of DevOps tools used in software development life cycle.
CO2: Make use of Jenkins to Build, Deploy and Test Software Applications.
CO3: Examine the different Version Control Strategies.
CO4: Analyze & Illustrate the Containerization of OS images and deployment of applications over Docker.
CO5: Summarize the importance of Software Configuration Management in DevOps.
CO6: Synthesize the provisioning using Chef/Puppet/Ansible/ Saltstack.

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	3	3					3	3	3	3	3
2	3	3	3	3	3				3	3	3	3	3	
3	3	3	3	3	3						3	3		2
4	3	3	3	3	3				3		3	3	3	
5	3	3	3	3	3				3	3	3	3		3
AVG	3	3	3	3	3				3	3	3	3	3	3

1-Low, 2-Medium, 3-High

COURSE CODE	PROJECT WORK AND VIVA VOCE	L	T	P	C
		0	0	12	6

COURSE OUTCOMES:

Upon completion of the course, the students will be able

CO1 : Apply algorithm and design techniques in the project and experience their outcome in their own real time project scenario.

CO2 : Develop the management skills to achieve the project goal by working as a team and enhance technical writing skills

CO3 : Examine mathematical techniques in various fields for solving computer engineering problems.

CO4 : Collaborate with various interdisciplinary projects to extend the domain knowledge of teams.

CO5 : Demonstrate the technical skills acquire to provide feasible solution for real-life problems

CO6 : Communicate and collaboratively work within peer groups to develop optimized hardware/software solutions

CO-PO & PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	3	3	3	3	3	2	3		2	3	3	3
2								3	3	3	2	3	3	3
3	2	3	3	3	3	3	3	2	3		2	3	3	3
4	2	3	3	3	3	3	3					3	3	3
5	2	3	3	3	3	3	3					3	3	3
6										3	2	3		
AVG	2	3	3	3	3	3	3	2	3	3	2	3	3	3

1-Low, 2-Medium, 3-High

COURSE CODE	ADVANCED ALGORITHMS	L	T	P	C
		3	0	0	3

MODULE I   ALGORITHMIC CONFLICTS   9

Insertion sort - Analyzing Algorithms - Designing algorithms. Growth of Functions: Asymptotic Notation -Standard notations and common functions. Divide-and-Conquer: The maximum - subarray problem -Strassen's algorithm for matrix multiplication -The substitution method for solving recurrences -The recursion - tree method for solving recurrences - The master method for solving recurrences

MODULE II   ADVANCED DESIGN AND ANALYSIS TECHNIQUES   9

Dynamic Programming: Rod cutting - Matrix-chain multiplication - Elements of dynamic programming -Longest common subsequence - Optimal binary search trees. Greedy Algorithms: An activity - selection problem - Elements of the greedy strategy - Huffman codes - Matroids and greedy methods - A task - scheduling problem as a matroid.

MODULE III   GRAPH ALGORITHM   9

Single - Source Shortest Paths: The Bellman-Ford algorithm - Single-source shortest paths in directed acyclic graphs - Dijkstra's algorithm - Difference constraints and shortest paths - Proofs of shortest - paths properties. All-Pairs Shortest Paths: Shortest paths and matrix multiplication - The Floyd-Warshall algorithm - Johnson's algorithm for sparse graphs. Maximum Flow: Flow networks - The Ford - Fulkerson method - Maximum bipartite matching - Push-relabel algorithms - The relabel-to-front algorithm.

MODULE IV   LINEAR PROGRAMMING AND STRING MATCHING   9

Linear Programming: Standard and slack forms - Formulating problems as linear programs - The simplex algorithm – Duality - The initial basic feasible solution. String Matching: The naive string - matching algorithm - The Rabin-Karp Algorithm - String matching with finite automata.

MODULE V   CONFIDENTIAL GEOMETRY AND APPROXIMATION ALGORITHMS   9

Computational Geometry: Line-segment properties - Determining whether any pair of segments intersects - Finding the convex hull - Finding the closest pair of points. Approximation Algorithms: The vertex-cover problem - The traveling-salesman problem - The set-covering problem - Randomization and linear programming - The subset-sum problem.

COURSE OUTCOMES

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

CO1: Develop a sound theoretical understanding on a wide range of algorithms and their relations

CO2: Develop basic knowledge on advanced algorithm design techniques and analysis skills.

CO3: Explore the functionalities of major graph Algorithms and their applications.

CO4: Design of Linear Programming and String Matching model for solving various applications.

CO5: Outline the basic concepts of Computational Geometry and develop algorithm analysis skills for analyzing the approximation ratio of approximation algorithms.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Fourth Edition, 2022.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to

Algorithms", Third Edition, 2009

REFERENCES:

1. Michael T. Goodrich and Roberto Tamassia,, "Algorithm Design: Foundations, Analysis, and Internet Examples", John Wiley and Sons,2002.
2. SanjayDasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill,2009
3. Steven S.Skiena, "The Algorithm Design Manual", Second Edition, 2010.
4. Udi Manbert, "Introduction to Algorithms, A Creative Approach", Addison-Wesley Publishing Company,1989.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2										3	2	3
2	3	3	3	3								3	2	3
3	1	2	3	2								3	2	3
4	3	3	3	3								3	2	3
5	3	3	3	3								3	2	3
AVg.	3	3	3	3								3	2	3

1-Low, 2-Medium, 3-High

COURSE CODE	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

MODULE I   FUNDAMENTALS OF COMPUTER DESIGN   **8**

Introduction - Classes of Computers - Trends in Technology - Trends in Power in Integrated Circuits - Trends in Cost - Dependability - Measuring - Reporting and Summarizing Performance – Quantitative Principles of Computer Design.

MODULE II   INSTRUCTION LEVEL PARALLELISM   **10**

Concepts and Challenges - Basic Compiler Techniques for Exposing ILP - Reducing Branch Costs with Prediction-Dynamic Scheduling - Hardware-Based Speculation - Advanced Techniques for Instruction Delivery and Speculation - Limitations of ILP.

MODULE III   THREAD LEVEL PARALLELISM   **9**

Symmetric Shared - Memory Architectures - Performance of Symmetric Shared - Memory Multiprocessors - Distributed Shared Memory and Directory-Based Coherence – Synchronization - Models of Memory Consistency.

MODULE IV   MEMORY   **10**

Memory Hierarchy Technology - Cache Memory organizations: Cache addressing models - Direct mapping and associative caches - Set associative and sector caches - Cache Performance issues. Virtual Memory Technology. Shared memory organizations: Interleaved memory organization - Bandwidth and fault tolerance - Memory allocation schemes.

MODULE V   MULTIVECTOR AND SIMD COMPUTERS   **8**

Vector Processing Principles - Multivector multiprocessors - SIMD computer organizations: Implementation models - CM2 network architecture - MasPar MP-1 architecture.

   COURSE OUTCOMES

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

CO1: Outline various performance parameters of computer design.

CO2: Analyze performance of different ILP techniques.

CO3: Understand the thread level parallel programming concepts.

CO4: Identify cache and memory related issues in multi-processors.

CO5: Describe concepts of vector processing and SIMD computers.

                                                                TOTAL: 45 PERIODS

 TEXT BOOKS:

1. John L Hennessey and David A Patterson, "Computer Architecture: A Quantitative Approach", Morgan Kaufmann; Sixth edition, 2017

2. Kai Hwang, "Advanced Computer Architecture - Parallelism, Scalability, Programmability", Tata McGraw Hill, Third edition, 2016.

 REFERENCES:

1. David E Culler, Jaswinder Pal Singh and Anoop Gupta, "Parallel Computer Architecture - A Hardware / Software approach", Amsterdam Elsevier 2015.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3											2	
2	3	3											2	
3	2	3											2	
4	2	3											2	
5	2	2											2	
AVg.	2	3											2	

1-Low, 2-Medium, 3-High

COURSE CODE	COMPILER DESIGN	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   3

Compilers and Interpreters - The structure of a Compiler - Phases of a compiler : Lexical analysis, Syntax analysis, Intermediate code generation, Code optimization, Code generation, Error handling - Passes of a compiler - Interleaving phases – Preprocessors - Compiler construction tools

MODULE II   HIGH-LEVEL PROGRAMMING LANGUAGES   2

Definition of Programming languages -The Lexical and Syntax structure of a language - Data environment - Parameter transmission - Storage management.

MODULE III   LEXICAL ANALYSIS   7

Finite Automata and Lexical Analysis: The role of Lexical Analyzers, Input Buffering - A simple approach to the design of Lexical analyzer - Regular expressions - Finite automata - Regular expression to Finite Automata - Minimizing the states of a DFA - A language for specifying lexical analyzers - Implementation of a lexical analyzer

MODULE IV   SYNTACTIC SPECIFICATION OF PROGRAMMING LANGUAGES   4

Grammar: Definition, Context sensitive, Context free, Regular grammar - Regular expression and Regular Grammars - Context Free Grammars: Notations - Derivations and Parse trees.

MODULE V   BASIC PARSING TECHNIQUES   9

Bottom-up parsing: Handle, Handle pruning - Operator precedence parsing - Simple precedence parsing- Top-down parsing: Recursive descent parsing, Predictive parsers-LR parsers: SLR parser, LALR Parser

MODULE VI   SYNTAX DIRECTED TRANSLATION   8

Syntax directed translation schemes- Synthesized and Inherited attributes - Implementation of syntax directed translators - Intermediate code - Postfix notation - Parse trees and Syntax trees - Three address code, Quadruples and Triples - Translation of assignment statement - Boolean expressions - Statements that alter the flow of control - Array references - Symbol tables: Contents, Structure

MODULE VII   INTRODUCTION TO CODE OPTIMIZATION   7

The Principle Sources of Optimization -Loop Optimization - The DAG representation of Basic Blocks - Global data flow analysis - Dominators- Reducible flow graphs - Loop invariant computations - Induction variable elimination - Other loop optimizations.

MODULE VIII   CODE GENERATION   5

Object programs - Issues in Code generation - A simple code generator - Register allocation and assignment - Code generation from DAG's - Peephole optimization.

COURSE OUTCOMES

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

CO1: Describe different phases of compilers.

CO2: Construct the Automata for accepting regular languages

CO3: Solve problems using different parsing techniques.

CO4: Demonstrate functions of compiler in Code optimization

CO5: Demonstrate the role of compiler in Code generation

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Alfred V.Aho, Monica S.Lam, Ravi Sethi and Jeffrey D.Ullman "Compilers: Principles, Techniques and Tools", Pearson Education Inc, Second Edition,2013.

2. Alfred V. Aho and Jeffrey D. Ullman, "Principles of Compiler Design", Narosa Publishing House pvt. ltd., Twenty fifth Reprint 2002.

REFERENCES:

1. Jean Paul Tremblay and Paul G.Sorenson., "Theory and Practice of Compiler Writing", BS Publication, Reprint 2008..

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2									1		
2	2	2	2									1		
3	2	2	2									1		
4	2	2	2									1		
5	2	2	2									1		
AVg.	2	2	2									1		

1-Low, 2-Medium, 3-High

COURSE CODE	COMPUTER VISION AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

MODULE I IMAGE PROCESSING FOUNDATIONS 9

Introduction–Image Processing Operations– Basic Image filtering operations: Noise Suppression by Gaussian Smoothing– Median Filters– Mode Filters– Rank Order Filters– The Role of Filters in Industrial Applications of Vision– Thresholding- Adaptive Thresholding – Edge detection techniques – corner and interest point detection – mathematical morphology – Some Basic Approaches to Texture Analysis.

MODULE II SHAPES AND REGIONS 9

Binary shape analysis – Connectedness – Object labeling and counting – Size filtering – Distance functions – Skeletons and thinning –Other Measures for Shape Recognition – Boundary tracking procedures – Boundary Pattern Analysis– Centroidal profiles – Problems– Plot- Handling occlusion– Accuracy of boundary length measures.

MODULE III THE HOUGH TRANSFORM 9

Line detection– Application of Hough Transform (HT) for line detection – The Foot-of-normal method – Longitudinal line localization – Final line fitting – Using RANSAC for straight line detection Circle and Ellipse Detection: HT for circular object detection – accurate center location – speed problem – ellipse detection – Case study- Human Iris location – hole detection– Generalized Hough Transform (GHT) – Spatial matched filtering – Use of GHT for Ellipse Detection.

MODULE IV   3D VISION AND MOTION 9

3-D Vision – Methods for 3D vision – projection schemes – shape from shading – photometric stereo – Surface Smoothness– shape from texture – use of structured lighting– three dimensional object recognition schemes– Image Transformations and Camera Calibration– Motion: Optical Flow– Interpretation– Time-to-Adjacency Analysis– Difficulties– Stereo from Motion– The Kalman Filter.

MODULE V APPLICATION 9

Automated Visual Inspection: Process– Types– Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application- Surveillance–foreground–background separation – particle filters – Chamfer matching – tracking and occlusion – combining views from multiple cameras – human gait analysis Application– In-vehicle vision system: locating roadway – road markings – road signs – locating pedestrians.

COURSE OUTCOMES

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

CO1: Implement fundamental image processing techniques required for computer vision.
CO2: Perform shape analysis and able to implement boundary tracking techniques
CO3: Apply Hough Transform for line, circle, and ellipse detections.
CO4: Apply 3D vision techniques and to implement motion related techniques.
CO5: Develop applications using computer vision techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.

2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.

3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University
   Press, 2012.

REFERENCES:

1. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition 5 Academic Press, 2012.

2. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.

3. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2								2	2	2
2	2	3	2	2								2	2	2
3	3	3	2	2								2	2	2
4	3	2	3	2								2	2	2
5	3	2	2									2	2	2
AVg.	3	2	2	2								2	2	2

1-Low, 2-Medium, 3-High

COURSE CODE	DISTRIBUTED SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

Characterization of Distributed Systems - Examples - Resource Sharing - Challenges - web. System Models - Architectural and Fundamental Models.

MODULE II   PROCESSES AND DISTRIBUTED OBJECTS   9

Inter Process Communication - The API for the Internet Protocols - External Data Representation and Marshalling - Client- Server Communication - Group Communication - Distributed Objects and Remote Invocation - Communication Between Distributed Objects - Remote Procedure Call.

MODULE III   OPERATING SYSTEM SUPPORT AND NAMING SERVICES   8

The OS Layer - Protection - Processes and Threads - Communication and Invocation - OS Architecture Distributed File Systems: File Service Architecture-Name Services: Name Services and the domain Name System-Directory Services.

MODULE IV   SYNCHRONISATION AND MUTUAL EXCLUSION   9

Time and Global States: Clocks, Events and Process States - Synchronizing Physical Clocks - Logical Time and Logical Clocks - Global States. Coordination and Agreement: Distributed Mutual Exclusion - Elections - Multicast Communication   .

MODULE V   CONSISTENCY AND REPLICATION   10

Data-centric consistency models: Continuous consistency- Consistent ordering of operations. Client-centric consistency models: Eventual consistency - Monotonic Reads - Monotonic Writes - Read your writes - Writes Follow Reads. Replica Management: Replica-Server Placement - Content Replication and Placement -Content Distribution. Consistency protocols: Continuous Consistency - Primary-Based Protocols - Replicated-Write Protocols - Cache- Coherence Protocols

COURSE OUTCOMES

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

CO1: Discuss the challenges and issues in applying various distributed system models in real time applications.

CO2: Demonstrate inter process communication using Remote Method Invocation and Remote Procedure Call

CO3: Describe the architecture and security provided by OS layer to support Distributed System

CO4: Identify the design issues related to naming services, synchronization and use synchronization algorithms in various distributed system scenarios.

CO5: Classify various consistency models in distributed environment.

CO6: Describe the approaches to achieve fault tolerance in distributed environment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Pearson Education, Fifth Edition, 2017.

2. Andrew S Tanenbaum, Maartenvan Steen,"Distributed Systems -Principles and Paradigms", Pearson Education, Second Edition, 2015. (consistency&replication only)Yunqian Ma, Gang Qian, "Intelligent Video Surveillance: Systems and Technology", CRC Press (Taylor and Francis Group), 2009

REFERENCES:
1. Ajay. D Kshem Kalyani, Mukesh Singhal, "Distributed computing principles, Algorithms and Systems", Cambridge University Press, First edition, 2011.
2. Mukesh Singhal, Niranjan G. Shivaratri, "Advanced concepts in Operating Systems", First Edition, Tata McGraw Hill, 2017.
3. M.L. Liu, "Distributed computing Principles and Applications", First Edition, Pearson Education, 2019.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	3	2											
2	3	3	3	3											
3	2	2	2	3											
4	3	3	3	3											
5	3	3	3	2	2				3	3		2	2	2	
6	3	3	3	2	2				3	3		2	2	2	
AVg.	3	3	3	3	2				3	3		2	2	2	

1-Low, 2-Medium, 3-High

COURSE CODE	EDGE AND FOG COMPUTING	L	T	P	C
		3	0	0	3

MODULE I   EDGE COMPUTING DEFINITION AND USE CASES   9
Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms: Virtualization – Containers – Use Cases for Edge Computing: Ambient Computing – Synthetic Sensing.

MODULE II   EDGE TO CLOUD PROTOCOLS   9
MQTT: MQTT publish-subscribe, MQTT architecture details, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.

MODULE III   MANAGEMENT AND ORCHESTRATION OF NETWORK SLICES IN 5G, FOG, EDGE, AND CLOUDS 9
Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds, IoT Integration, Security Management for Edge Cloud Architectures.

MODULE IV   FOG COMPUTING REQUIREMENTS WHEN APPLIED TO IOT   9
Scalability, Interoperability, Fog-IoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virtualization, security and privacy issues.

MODULE V   FOG COMPUTING APPLICATIONS   9
Exploiting Fog Computing in Health Monitoring: An Architecture of a Health Monitoring IoT- Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, Fog Computing Model for Evolving Smart Transportation Applications: Introduction, Data-Driven Intelligent Transportation Systems, Fog Computing for Smart Transportation Applications Case Study: Intelligent Traffic Lights Management (ITLM) System. The Firefly algorithm.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: Describe the purpose, use cases and platforms for Edge Computing.
CO2: Demonstrate the operations of MQTT used for Edge to Cloud protocols
CO3: Apply network slicing and middleware concept in Edge and Fog Computing.
CO4: Describe the requirements necessary for fog computing when applied to IoT.
CO5: Analyze various applications in fog computing.

                                                                    TOTAL: 45 PERIODS

TEXT BOOKS:

1.   IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806

2.   Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya, Wiley; 1st edition (20 May 2020)

3.   Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama

REFERENCES:

1. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.

2. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2											1
2	2	2	2	2										1
3	2	2	2											1
4	2	2	2											1
5	2	2	2		2									2
AVg.	2	2	2	2	2									1

1-Low, 2-Medium, 3-High

COURSE CODE	GRAPH THEORY	L	T	P	C
		3	0	0	3

MODULE I   FOUNDATIONS   8

Foundations: Graphs - Paths - Cycles and Trails - Vertex Degrees and Counting - Directed Graphs. **Trees and Distances:** Properties - Spanning Trees and Enumerations - Optimization and Trees.

MODULE II   MATCHING AND FACTORS   5

Matching and Factors: Matching and Covers - Bipartite Graphs Matching - Matching in General Graphs.

MODULE III   PATHS CONNECTIVITY AND GRAPH COLORING   10

Paths and Connectivity: Cuts and Connectivity - k-Connected Components - Network Flow Problems. **Graph Coloring**: Vertex Colouring and its Upper Bound Analysis - k-chromatic graph structures and Enumerative aspects of Graph Colouring.

MODULE IV   PLANAR GRAPHS   6

Planar Graphs: Embedding - Properties of Planar Graphs and Planarity Parameters.

MODULE V   EDGES AND CYCLES   6

Line Graphs and Edge – colouring - Hamiltonian cycles - Planarity graphs - Coloring and Cycles: Taits Theorem - Grinberg's Theorem

MODULE VI   MATROIDS AND EIGEN VALUES OF GRAPHS   10

Matroids: Properties- The Span function-The Dual of a Matroid. **Eigen Values of Graphs:** Characteristic Polynomial-Linear Algebra of Real Symmetric Matrices- Eigen Values and Graph Parameters – Eigen Values of Regular Graph.

COURSE OUTCOMES

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

CO1: Describe the characteristics and types of graphs.

CO2: Use Special types of Graphs for Modeling and analyzing real-world complex networks.

CO3: Deploy Graph Coloring Techniques to solve topological problems.

CO4: Solve Combinatorial Optimization and Geometrical problems using Graph Theoretic approaches.

CO5: Evaluate Graph Theory Algorithms in real world applications.

                                                              TOTAL: 45 PERIODS

TEXT BOOKS:

1. Douglas. B. West," Introduction to Graph Theory", Pearson Education, Second Edition, reprint 2017.

2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science",   Dover Publications, First Edition, 2016.

REFERENCES:

1. Reinhard Diestel, "Graph Theory", Springer Publications, 5th Edition, 2016.

2. Bondy. J.A. and Murthy. U.S. R, "Graph Theory with Applications", Elsevier science ltd / North – Holland 1976.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2											
2	3	3	3	3											
3	3	3	3	3											
4	3	3	2	2											
5	3	3	2	2									2	2	
AVg.	3	3	3	2									2	2	

1-Low, 2-Medium, 3-High

COURSE CODE	GRAPHICS AND MULTIMEDIA SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I   GRAPHICS PRIMITIVES, 2D TRANSFORMATION AND VIEWING   9

Output primitives: points and lines - line drawing algorithms - circle and ellipse drawing algorithms - polygon generating and filling algorithms. 2D Transformations: Basic Transformations - matrix representation - translation - rotation - scaling - general pivot point rotation - general fixed-point scaling - general scaling directions - reflection - shear. Viewing: window to view port coordinate transformation - point clipping - Cohen and Sutherland line clipping algorithm - Sutherland and Hodgeman polygon clipping algorithm.

MODULE II   3D CONCEPTS, TRANSFORMATION AND VIEWING   9

3D display methods- 3D object representation: polygon surfaces - curved lines and surfaces - Quadric surfaces - Introduction to Spline Representations - Bezier curves and surfaces. 3D Transformations: Translation - Rotation - Scaling - 3D Viewing: view plane - projections - clipping.

MODULE III   MULTIMEDIA SYSTEM DESIGN   9

Elements - Applications - Multimedia system architecture - Evolving technologies for Multimedia system - Defining objects - Multimedia Data Interface standards - Multimedia databases.

MODULE IV   COMPRESSION AND DECOMPRESSION   9

Need for Data Compression - Types - Binary Image Compression Schemes - Color, Gray Scale and Still Video Image Compression -Video Image Compression - Audio Compression.

MODULE V   MULTIMEDIA APPLICATIONS   9

Content Based Information Retrieval - Multimedia Communications- Multimedia Information Sharing and Retrieval – Applications - Social Media Sharing, Online Social Networking- Virtual Reality- Multimedia for Portable Devices- Collaborative Multimedia Applications.

COURSE OUTCOMES

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

CO1: Demonstrate the working of graphics output primitive algorithms, clipping algorithms and apply two dimensional geometric transformations.

CO2: Illustrate three-dimensional object representation, transformations and concepts involved in spline representation.

CO3: Describe the Multimedia concepts, its architecture and its real-world applications.

CO4: Analyze various compression techniques for the efficient transmission of Multimedia data.

CO5: Outline the technologies used in various multimedia applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Donald Hearn and Pauline Baker M., "Computer Graphics", Prentice Hall of India, Second Edition, 2008.
2. Prabhat K Andleigh and Kiran Thakrar, "Multimedia Systems and Design", Prentice Hall of India, Reprint 2007. (Multimedia Systems Design, Compression and Decompression)
3. Ze Nian Li, Mark S Drew and Jiangchuan Liu, "Fundamentals of Multimedia", Third Edition, Springer, 2021. (Multimedia Applications)

REFERENCES:

1. Atul P. Godse, Dr. Deepali A. Godse ,"Computer Graphics and Multimedia",First Edition,2021
2. Gaurav Bhatnagar,shikha Mehta,Sugata Mitra,"Introduction ntroduction to Multimedia Systems",2002.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2								2	2	
2	3	2	2	2	1							1	1	
3	3		2		2		2		2		2		1	
4	3		2		2		2		2		2			1
5	3	2		2								1		1
AVg.	3	2	2	2	2		2		2		2	1	1	1

1-Low, 2-Medium, 3-High

COURSE CODE	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS   **9**

Introduction: Introduction & Applications, Elements of visual perception, Image sensing and acquisition, simple image formation, Image sampling and Quantization, Representing digital pixels, Image quality, Introduction to colour image – RGB and HSI Models.

Image enhancement in Spatial domain: Introduction to image enhancement, basic grey level transforms, Histogram, Histogram-processing equalization, Matching & colour histogram, Enhancement using arithmetic/logic operations, spatial filtering, smoothing spatial filtering, Sharpening spatial filtering.

MODULE II   IMAGE ENHANCEMENT TECHNIQUES   **9**

Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation.

MODULE III   VIDEO ANALYTICS   **9**

Introduction: Video Basics - Fundamentals for Video Surveillance- Scene Artifacts, Object Detection and Tracking: Adaptive Background Modelling and Subtraction- Pedestrian Detection and Tracking- Vehicle Detection and Tracking- Articulated Human Motion Tracking in Low Dimensional Latent Spaces.

MODULE IV   BEHAVIOURAL ANALYSIS & ACTIVITY RECOGNITION   **9**

Event Modelling: Behavioural Analysis, Human Activity Recognition: Complex Activity Recognition- Activity modelling using 3D shape, Video summarization, shape-based activity models, Suspicious Activity Detection.

MODULE V   HUMAN FACE RECOGNITION & GAIT ANALYSIS   **9**

Introduction: Overview of Recognition algorithms – Human Recognition using Face - Face Recognition from still images - Face Recognition from video - Evaluation of Face Recognition Technologies, Human Recognition using gait: HMM Framework for Gait Recognition - View Invariant Gait Recognition - Role of Shape and Dynamics in Gait Recognition

COURSE OUTCOMES

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

CO1: Comprehend the relation between human visual system and machine perception and processing of digital images

CO2: Illustrate the various approach of image enhancement techniques like filtering, smoothing and segmentation

CO3: Demonstrate surveillance videos for analytics

CO4: Design of optimization algorithms for better analysis and recognition of objects in a scene

CO5: Develop Model framework for Human Activity Recognition

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods,"Digital Image Processing ", Fourth Edition, Pearson, 2018

2. Scotte Umbaugh ,"Digital Image Processing and Analysis-Human and Computer Vision Application

with MATLAB using CVIP Tools", Third Edition, CRC Press, 2017

3. Yunqian Ma, Gang Qian, "Intelligent Video Surveillance: Systems and Technology", CRC Press (Taylor and Francis Group), 2009

4. Rama Chellappa, Amit K.Roy-Chowdhury, Kevin Zhou.S, "Recognition of Humans and their activities using Video", Morgan & Claypool Publishers, 2005

REFERENCES:
1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010
2. Murat Tekalp A, "Digital Video Processing", Prentice Hall International

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	2	3	3	3							3	1	3
2	2	3	3	3	3							3	1	3
3	1	3	3	3	3							3	1	3
4	1	3	3	3	3							3	1	3
5	1	3	3	3	3							3	1	3
AVg.	1	3	3	3	3							3	1	3

1-Low, 2-Medium, 3-High

COURSE CODE	OPEN SOURCE SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO OPEN SOURCE TECHNOLOGIES   8

Overview of Free/Open Source Software - Definition of FOSS & GNU - History of GNU/Linux and the Free Software Movement - Linux Distributions - Advantages of Free Software and GNU/Linux - Free Software Licenses- GUN Build systems: Autoconf , Automake, Libtool, Autogen, GNU make

MODULE II   OPEN SOURCE NON-RELATIONAL DATABASES   10

Why NoSQL - Aggregate Data Models - More Details on Data Models - Distribution Models - Consistency.

MODULE III   IMPLEMENTATION OF NON-RELATIONAL DATABASES   10

Types - NON relational database- Document Databases -Graph Databases -Case study: Cassandra Query Language

MODULE IV   OPEN SOURCE PROGRAMMING LANGUAGES   9

PHP: Essential PHP- Operators and flow control- Strings and Arrays – Functions – PHP Browser Handling power - Working with PHP and MYSQL   database –Python: Numerical computations.

MODULE V   OPEN SOURCE WEB SERVER AND LIBRARIES   8

Introduction - Starting, Stopping and restarting Apache- Configuration - Securing Apache – MDA. Open Source math Libraries: BLAS, NTL, GSL

COURSE OUTCOMES

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

CO1: State the various open source Licenses and understand the Linux build systems.

CO2: Illustrate the concept of NoSQL Databases for various types.

CO3: Design Appropriate No-SQL DataBase Types for real time applications

CO4: Implement NoSQL Database for real world application

CO5: Demonstrate ability to learn and use programming language/scripts (such as PHP & Python) to develop simple applications.

CO6: Discuss the configuration of Apache web servers and use of open source libraries

TOTAL: 45 PERIODS

TEXT BOOKS:

1.   James Lee and Brent Ware, "Open Source Web Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP", Addison Wesley Publisher, First Edition, 2002. (Introduction to Open Source Technologies, Open Source Programming Languages, Open source web server)

2.   Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled A Brief Guide to the Emerging World of Polyglot Persistence", Addison Wesley, Reprint 2013. (Open Source Non-Relational Databases, Types Of Non-Relational Databases)

3.   Sandeep Koranne, "Handbook of open source tools", Springer Science and Business media, Heidelberg, 2011(Open source tools)

REFERENCES:

1.   N. B. Venkateshwarlu, "Introduction to Linux: Installation and Programming (Ed)", BS Publishers (An NRCFOSS Publication) Reprint 2014.

2.   Steven Holzner, "PHP: The Complete Reference", TMH Edition Second Reprint 2007

3.   Wesley J.Chun, "Core Python Programming" Prentice Hall, Second Edition, 2007.
4.   Stephen J. Mellor and Marc Balces, "Executable UMS: A foundation for MDA", Addison Wesley, First
Printing 2002.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3				3								3	3	
2	3		3										3	3	
3	3		3						3				3	3	
4	3		3						2				3	3	
5	3		3		3				3				3	3	
AVg.	3		3		3				3				3	3	

1-Low, 2-Medium, 3-High

COURSE CODE	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO OPTIMIZATION   9

Engineering application of Optimization – Statement of an Optimization problem – Optimal Problem formulation – Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria – Review of basic calculus concepts – Global optimality.

MODULE II LINEAR PROGRAMMING METHODS FOR OPTIMUM DESIGN   9

Review of Linear programming methods for optimum design – Post optimality analysis – Application of LPP models in design and manufacturing.

MODULE III UNCONSTRAINED OPTIMIZATION PROBLEMS   9

Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method- Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method.

MODULE IV MODERN METHODS OF OPTIMIZATION   9

Genetic Algorithms – Simulated Annealing – Ant colony optimization – Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications.

MODULE V CLASSICAL OR CONVENTIONAL SEARCH TECHNIQUE   9

Metaheuristics- Swarm Intelligence based Algorithms– Particle Swarm Optimization –Artificial Bee colony algorithm- Ant Colony Optimization- The Firefly algorithm.

COURSE OUTCOMES

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

CO1: Formulate the engineering problems as an optimization problem

CO2: Apply necessary and sufficient conditions for a given optimization problem for optimality

CO3: Select appropriate methods to interpret and analyse the solution obtained by optimization algorithms

CO4: Justify and apply the use of modern heuristic algorithms for solving optimization problems.

CO5: Inculcate modelling skills necessary to describe and formulate metaheuristics optimization problems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rao S. S. – 'Engineering Optimization, Theory and Practice' – New Age International Publishers – 2012 – 4th Edition.
2. Xin-She Yang. Nature-inspired Metaheuristic Algorithms. United Kingdom: Luniver Press 2010

REFERENCES:

1. Modestus O. Okwu, Lagouge K. Tartibu –'Metaheuristic Optimization: Nature-Inspired Algorithms Swarm and Computational Intelligence, Theory and Applications 2020.
2. Arora J. – 'Introduction to Optimization Design' – Elsevier Academic Press, New Delhi – 2004.
3. Deb K. – 'Optimization for Engineering Design Algorithms and Examples' – PHI – 2000
4. Saravanan R. – 'Manufacturing Optimization through Intelligent Techniques' – Taylor & Francis (CRC Press) – 2006

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	2								2		
2	3	3	3	3								2		
3	3	3	3	3								2		3
4	3	3	3	3	2							2		3
5	3	3	3	3	3							2		3
AVg.	3	3	3	3	2							2		3

1-Low, 2-Medium, 3-High

COURSE CODE	PARALLEL COMPUTING	L	T	P	C
		3	0	0	3

MODULE I   SCALABILITY AND CLUSTERING   9

Evolution of Computer Architecture – Dimensions of Scalability – Parallel Computer Models – Basic Concepts of Clustering – Scalable Design Principles – Parallel Programming Overview – Processes, Tasks and Threads – Parallelism Issues – Interaction / Communication Issues – Semantic Issues in Parallel Programs.

MODULE II   ENABLING TECHNOLOGIES   9

System Development Trends – Principles of Processor Design – Microprocessor Architecture Families – Hierarchical Memory Technology – Cache Coherence Protocols – Shared Memory Consistency – Distributed Cache Memory Architecture – Latency Tolerance Techniques – Multithreaded Latency Hiding.

MODULE III   SYSTEM INTERCONNECTS   9

Basics of Interconnection Networks – Network Topologies and Properties – Buses, Crossbar and Multistage Switches, Software Multithreading – Synchronization Mechanisms.

MODULE IV   PARALLEL PROGRAMMING   9

Paradigms And Programmability – Parallel Programming Models – Shared Memory Programming.

MODULE V   MESSAGE PASSING PROGRAMMING   9

Message Passing Paradigm – Message Passing Interface – Parallel Virtual Machine.

 COURSE OUTCOMES

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

 CO1: Identify the scalability and clustering issues and the technology necessary for Parallel Computing.

 CO2: Describe the technologies enabling parallel computing.

 CO3: Outline different types of interconnection networks.

 CO4: Demonstrate different parallel programming models.

 CO5: Analyze the software support needed for shared memory programming.

                                                                      TOTAL: 45 PERIODS

 TEXT BOOKS:

 1. Kai Hwang and Zhi.Wei Xu, "Scalable Parallel Computing", Tata McGraw-Hill, New Delhi, 2003.

 2. Michael J. Quinn, "Parallel Computing Theory and Practice", McGraw Hill Education; 2nd edition, 2017

 REFERENCES:

 1. David E. Culler & Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/Software Approach", Morgan Kaufman Publishers, 1999

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1												2	
2	2	2												2	
3	2	2												2	
4	2	2												2	
5	2	2												2	
AVg.	2	2												2	

1-Low, 2-Medium, 3-High

COURSE CODE	SOFT COMPUTING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO SOFT COMPUTING   9

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

MODULE II   ARTIFICIAL NEURAL NETWORKS   9

Back propagation Neural Networks – Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network – Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines – Spike Neuron Models.

MODULE III   FUZZY SYSTEMS   9

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets – Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification – Fuzzy Arithmetic and Fuzzy Measures -Fuzzy Rule Base and Approximate Reasoning – Introduction to Fuzzy Decision Making.

MODULE IV   GENETIC ALGORITHMS   9

Basic Concepts- Working Principles -Encoding- Fitness Function – Reproduction -Inheritance Operators – Cross Over – Inversion and Deletion -Mutation Operator – Bit-wise Operators - Convergence of Genetic Algorithm.

MODULE V   HYBRID SYSTEMS   9

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination – LR-Type Fuzzy Numbers – Fuzzy Neuron – Fuzzy BP Architecture – Learning in Fuzzy BP- Inference by Fuzzy BP – Fuzzy ArtMap: A Brief Introduction – Soft Computing Tools –GA in Fuzzy Logic Controller Design – Fuzzy Logic Controller.

COURSE OUTCOMES

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

CO1: Outline the basic concepts of Soft Computing.

CO2: Design of Artificial Neural Networks for Various applications.

CO3: Develop suitable fuzzy models for solving real world problems.

CO4: Describe Genetic Algorithms and their applications.

CO5: Integrate various soft computing techniques for complex problems..

                                                            TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, ―Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.
2. Kwang H.Lee, ―First course on Fuzzy Theory and Applications, Springer, 2005.
3. George J. Klir and Bo Yuan, ―Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice

Hall, 1996.

4. James A. Freeman and David M. Skapura, —Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1										2		2
2	3	2	3	3	3							3		3
3	3	3	2	2	2							2		2
4	3	3	3	2	3							2		3
5	3	3	3	3	3							3		3
AVg.	3	2	3	3	3							3		3

1-Low, 2-Medium, 3-High

COURSE CODE	USER EXPERIENCE DESIGN(UX) DESIGN FOR EXTENDED REALITY(XR)	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION AND USER OBSERVATION AND EXPERIENCE   12

Introduction about UX - Five Main Ingredients of UX - Three "Whats" of User Perspective - Pyramid of UX Impact - UX Is a Process - UX - Not an Event or Task. Behaviour Basics: Psychology versus Culture - User Psychology - Experience - Conscious vs Subconscious Experience - User Research - Subjective Research - Objective Research - Sample Size - Three Basic Types of Questions. Observe a User: Watch How They Choose - Interviews - Surveys - Card Sorting - Creating User Profiles - Bad profile - Useful profile.

MODULE II USER INTERFACE DESIGN PRINCIPLES   12

Designing Behaviour: Designing with Intention - Rewards and Punishments - Conditioning and Addiction - Timing Matters - Gamification - Social/Viral Structure–Trust - Hidden versus Visible. Basic Visual Design Principles: Visual Weight - Contrast - Depth and Size - Color. Layout: Page Framework - Footers - Navigation -Images, and Headlines - Forms - One Long Page or a Few Short Pages - Input Types - Labels and Instructions - Primary and Secondary Buttons - Adaptive and Responsive Design - Touch versus Mouse.

MODULE III WEB INTERFACE DESIGN   10

Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow – Using Motion for UX - Design Pattern: Z-Pattern - F-Pattern - Visual Hierarchy - Lookup patterns – Feedback patterns.

MODULE IV MOBILE INTERFACE DESIGN   11

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools-Explainable AI.

COURSE OUTCOMES

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

CO1: Illustrate the fundamental concepts of User Experience (UX) design and its Importance.

CO2: Describe effective user experience and the psychology behind user decision making.

CO3: Apply design principles to create intentional user interfaces.

CO4: Apply basic visual design principles to create visually appealing interfaces.

CO5: Outline the concepts of designing web interface.

CO6: Develop meaningful user interface for mobile applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Joel Marsh, "UX for Beginners", O'Reilly Media, Inc., 1 st Edition 2015.

2. Xia Jiajia, "UI UX Design", O'Reilly, Artpower International, 2016.

3. Brian Fling, "Mobile Design and Development", O"Reilly Media Inc., 1st Edition, 2009.

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004.

2. Alan Cooper, "The Essential of User Interface Design", Wiley Dream Tech Ltd., 2002.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3											3		
2	3	3			3				3				3		
3	3	3	3		3								3		
4	3		3		3				2				3		
5	3		3		2				3				3		
6	3		3		3				3				3		
AVg.	3	3	3		3				3				3		

1-Low, 2-Medium, 3-High

COURSE CODE	PROGRAMMING IN JAVA	L	T	P	C
		3	0	0	3

MODULE I   OBJECT ORIENTED PROGRAMMING   9

Introduction to object oriented languages - Evolution of object oriented languages - Object oriented programming paradigm - Basic concepts of object oriented programming - Procedural Vs object oriented programming.

MODULE II   INTRODUCTION TO JAVA   9

Java and Internet - Byte Code - Features of Java - Java Development Environment- Java Programming: Methods and Classes - Constructor - Garbage Collection - Overloading - Inheritance - Overriding - Packages and Interfaces - Java IO systems - String Handling : String and String Buffer.

MODULE III   EXCEPTION HANDLING   9

Exception Handling: Fundamentals of Exception handling and types - Built in Exceptions - user defined Exceptions.

MODULE IV   MULTI THREADS   9

Multithreaded Programming: Thread Model -Thread properties -Thread priorities -Synchronization- Inter thread communication- Networking : Inet address - Datagrams - Sockets - URL connections.

MODULE V   APPLET AND DATABASE CONNECTIVITY   9

Introduction to Abstract Window Tool kit - Applet class - HTML applet tags - Parameter passing - Audio clip interface - Event class: Keyboard and Mouse events handling.

COURSE OUTCOMES

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

CO1: Describe the fundamental aspects of object oriented programming paradigm.

CO2 : Develop java programs using features like methods, classes, constructors, overloading and string handling.

CO3 : Write exception handling routines for practical applications.

CO4:Describe multithreading, synchronization and networking features of Java.

CO5:Demonstrate use of applets and database connectivity in developing practical Applications

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Herbert Schilt :"Java 2 - Complete references ", Tata McGraw Hill, twelth Edition, McGraw Hill Education, 2021.

REFERENCES:

1. Deitel H.M and Deitel P.J, "Java - How to Program", Prentice Hall of India, Eleventh Edition, 2018.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2											1			
2	2	3	3	3								1			
3	2	3	3	3								1			
4	2	3	3	3								1			
5	2	3	3	3								1			
AVg.	2	3	3	3								1			

1-Low, 2-Medium, 3-High

COURSE CODE	CLOUD COMPUTING FUNDAMENTALS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

Understanding Cloud Computing- history of cloud computing: Client/Server computing, Peer to peer computing, Distributed computing and Collaborative computing.- Understanding cloud architecture, cloud storage and services-Pros and cons of cloud computing.

MODULE II   VIRTUALIZATION   9

Introduction-Characteristics of Virtualized Environments - Taxonomy of Virtualization Techniques - Virtualization and Cloud Computing - Pros and Cons of Virtualization - Technology Examples.

MODULE III   CLOUD COMPUTING ARCHITECTURE   9

Cloud reference model: Architecture, Infrastructure / Hardware as a service, Platform as a service-Software as a service, Types of cloud: Public clouds, Private clouds, Hybrid Cloud, Community Clouds..

MODULE IV   CLOUD SERVICES   9

Discovering Cloud services Development services and tools: Amazon, Google App Engine, IBM, Salesforce.com, Other Cloud Services development tool

MODULE V   CLOUD SECURITY   9

Security Overview - Cloud Security Challenges - Software as a Service Security - Security Governance - Risk Management - Security Monitoring - Security Architecture Design - Data Security - Application Security - Virtual Machine Security.

COURSE OUTCOMES

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

CO1: Outline the client- server, distributed collaborative and cloud computing architecture along with cloud storage and services.

CO2 : Classify the different virtualization environments and techniques.

CO3: Illustrate various services deployed from a cloud architecture supported by different providers.

CO4: Analyze the major security challenges and privacy problems in the cloud and virtual environment

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael Miller "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online",1st Edition, Pearson Education, New Delhi, 2009.
2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013.(Virtualization, Cloud Computing Architecture)
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010. (Cloud Security)

REFERENCES:

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
2. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2002.
3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From

Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2002.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2									1			
2	2	2	2									1			
3	2	2	2									1			
4	2	2	2									1			
AVg.	2	2	2									1			

1-Low, 2-Medium, 3-High

COURSE CODE	INFORMATION SECURITY FUNDAMENTALS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION, NEED FOR SECURITY   9

Introduction to Information Security - The History of Information Security- Critical Characteristics of Information - NSTISSC Security Model - Components of an Information System - Securing Components - Balancing Information Security and Access - The Systems Development Life Cycle - The Security Systems Development Life Cycle. The Need for Security: Introduction Business Needs First -Threats -Attacks.

MODULE II   RISK MANAGEMENT AND INFORMATION SECURITY   9

Introduction - An Overview of Risk Management - Risk Identification -Risk Assessment - Risk Control Strategies - Selecting a Risk Control Strategy - Risk Management Discussion Points - Recommended Practices in Controlling Risk.

MODULE III   POLICIES, STANDARDS, PRACTICES AND BUSINESS CONTINUITY   9

Introduction - Information Security Policy, Standards and Practices -The Information Security Blueprint: ISO 17799/BS 7799, ISO 27001and its controls, NIST Security Models, Design of Security Architecture - Security Education, Training and Awareness Program - Continuity Strategies.

MODULE IV   SECURITY TECHNOLOGY   9

Introduction - Intrusion Detection and Prevention Systems: IDPS Terminology, Use of IDPS, Strengths and Limitations of IDPS - Honey Pots, Honey Nets, and Padded Cell Systems - Scanning and Analysis Tools, Access Control Devices

MODULE V   BIOMETRIC CONTROLS   9

Biometrics - Nature of Biometrics Identification/Authentication Techniques - Biometric Techniques - Matching and Enrollment Process in Biometrics - Benefits Over Traditional Authentication Methods.

COURSE OUTCOMES

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

CO1: Identify and analyze the security threats and attacks and apply device suitable security policies and standards.

CO2 : Assess the risks and apply suitable risk control strategies.

CO3: Employ appropriate intrusion detection and prevention systems to ensure information security.

CO4: Discuss various national and international laws of information security and its framework.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Course Technology, New Delhi, Fourth Edition, 20f2 Reprint.
2. Nina Godbole, "Information Systems Security-Security Management, Metrics, Frameworks and Best Practices", Wiley India Pvt. Ltd., New Delhi, First Edition, 2009.(Biometric Controls, Security of Wireless Networks, Laws and Legal Framework)

REFERENCES:

1. Thomas R.Pettier, "Information Security Fundamentals", Auerbach Publications, Second Edition, 2013.
2. Vicki Krause and Harold F.Tipton, "information Security Management Handbook", Auerbach Publications, Sixth Edition,2008.
3. Mark Merkow and Jim Breithaupt," Information Security - Principles & Practices", Second Edition,

Pearson Education, 2014.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2			2						1			
2	2	2	2			2						1			
3	2	2	2			2						1			
4	2	2	2			2						1			
AVg.	2	2	2			2						1			

1-Low, 2-Medium, 3-High

COURSE CODE	DEEP LEARNING	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO FEED FORWARD NETWORKS   9

Basics: Biological Neuron, Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm - Representation Power of Feedforward Neural Networks, Backpropagation, Empirical Risk Minimization

MODULE II REGULARIZATION   9

Parameter norm Penalties - Regularization and Under-Constrained Problems- Dataset Augmentation- Noise Robustness- Multi-task learning- Early Stopping- Parameter Typing and Parameter Sharing- Sparse Representations- Bagging and other Ensemble Methods- Dropout-Adversarial Training, Tangent Distance, tangent Prop and Manifold, Tangent Classifier.

MODULE III OPTIMIZATION FOR TRAINING DEEP NEURAL NETWORKS   9

Challenges of training deep neural networks- Gradient Descent (GD) - Stochastic Gradient Descent (GD), Parameter Initialization Strategies- Optimization methods for neural networks :Adagrad - Rmsprop - Adam- Optimization Strategies: Batch Normalization - Supervised Pre-training

MODULE IV CONVOLUTIONAL NEURAL NETWORKS   9

Convolution Operation - Motivation for CNN - Pooling-Architecture, LeNet, AlexNet, Visualizing Convolution Neural Networks: Applications: Image recognition, Video analysis, Drug discovery.

MODULE V RECURRENT NEURAL NETWORKS   9

Long Short Term Memory, Bidirectional LSTMs, Bidirectional RNNs. Applications: Machine Translation, Robot control, Handwriting recognition.

COURSE OUTCOMES

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

CO1 : Implement basic neural network model with hidden layers.

CO2 : Apply appropriate regularization methods in given data.

CO3 : Optimize the deep neural network using various optimization strategies

CO4 : Design convolutional neural network (CNN, or ConvNet) to perform data analysis on visual imagery.

CO5 : Design Recurrent Neural Network (RNN) and its temporal dynamic behavior for sequence based data.

CO6 : Develop deep learning model for real world problems.

                                                                    TOTAL : 45 PERIODS

TEXT BOOKS:

   1. Ian Goodfellow and Yoshua Bengio and Aaron Courville., " Deep Learning ",MIT Press, 2016.
   2. Christopher Bishop., " Pattern Recognition and Machine Learning ", Springer,2007.

REFERENCES:

   1.   Raúl Rojas, " Neural Networks: A Systematic Introduction ", Springer-Verlag, Berlin,1996.
   2.   Yegnanarayana, B., " Artificial Neural Networks ", PHI Learning Pvt. Ltd, 2009.
   3.   Golub, G.,H., and Van Loan,C.,F., " Matrix Computations ", JHU Press,2013.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1									3	1	3
2	2	3	3	3	3							3	1	3
3	2	3	3	3	3							3	1	3
4	2	3	3	3	3							3	1	3
5	2	3	3	3	3							3	1	3
AVg.	2	3	3	3	3							3	1	3

1-low, 2-medium, 3-high

COURSE CODE	BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

MODULE I BUSINESS INTELLIGENCE AND ITS COMPONENTS   **9**

Introduction to OLTP and OLAP (MOLAP, ROLAP, HOLAP), Business Intelligence Definitions and Concepts, Business Intelligence Framework-Data Warehousing Concepts and Its Role in Business Intelligence; Business Intelligence Infrastructure Components - Business Intelligence Process, Business Intelligence Technology, Business Intelligence Roles and Responsibilities, Business Applications of Business Intelligence, Business Intelligence Best Practices

MODULE II BASICS OF DATA INTEGRATION (Extraction Transformation Loading)   **9**

Concepts of Data Integration , Needs and Advantages of using Data Integration , Introduction to Common Data Integration Approaches ; Meta Data – Types and Sources , Introduction to Data Quality , Data Profiling Concepts and Applications, Introduction to ETL using Kettle

MODULE III MULTI-DIMENSIONAL DATA MODELING   **9**

Data Modelling Basics-Types of Data Model-Data Modelling Techniques-Fact Table-Dimension Table-Dimensional Models-Dimensional Modelling Lifecycle and Design- Creating Cubes using Microsoft Excel. Introduction to Business Metrics -Fact Based Decision Making and KPIs-KPIs usage in companies

MODULE IV PREDICTION MODELS FOR BUSINESS INTELLIGENCE   **9**

Simple Linear Regression Model – Least Squares Method – Multiple Regression Model – Multiple Regression using Excel – Time Series Analysis: Time Series Patterns – Forecast Accuracy – Moving averages and Exponential Smoothing – Regression Analysis for Forecasting: Linear Trend Projection – Seasonality – Seasonality without Trend – Seasonality with Trend.

MODULE V BASICS OF ENTERPRISE REPORTING   **9**

A Typical Enterprise, Malcolm Bridge – Quality Performance Framework, Reporting Perspectives – Report Standardization and Best Practices - Balanced Scorecard, Enterprise Dashboard, Balanced Scorecard vs. Enterprise Dashboard- Funnel Analysis, Enterprise Reporting using MS Access / MS Excel

COURSE OUTCOMES

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

CO1: Describe Business Intelligence components and Data-warehouse concepts in practice.

CO2: Apply the concepts of Data Extraction, Transformation and loading for Data Integration

CO3: Apply the concepts of Multidimensional Data Modeling in business applications

CO4: Perform decision making based on business metrics and KPIs.

CO5: Develop predictive models for prediction and forecasting in business analysis

CO6: Create enterprise reports using reporting techniques for business applications

TOTAL : 45 PERIODS

TEXT BOOKS:

1. RN Prasad and Seema Acharya,"Fundamentals of Business Analytics", Wiley India, 2020.
2. Camm, Cochran, et al., "Essentials of Business Analytics", Cengage Learning,2015 (For Prediction Models for Business Intelligence only).

REFERENCES:

1. James R. Evans, "Business Analytics", 3rd edition, Pearson, 2020.

2. David Loshin ,” Business Intelligence”, Second Edition ,Elsevier Science and Technology,2012.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2										2		3
2	2	2	3	3	3						3	3		3
3	2	3	3	3	3						3	3		3
4	2	3	3	3	3						3	3		3
5	2	3	3	3	3						3	3		3
6	2	3	3	3	3						3	3		3
AVg.											3	3		3

1-low, 2-medium, 3-high

COURSE CODE	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION AND NETWORK MEASURES   **9**

Introduction to Social Network Analysis – Applications – Preliminaries – Three levels of Social Network Analysis – Historical Development – Graph Visualization Tools – Network Measures: Network Basics – Node Centrality – Assortativity – Transitivity and Reciprocity – Similarity – Degeneracy

MODULE II NETWORK GROWTH MODELS AND LINK ANALYSIS   **9**

Properties of Real world networks – Random Network Model – Ring Lattice Model – Watts-Strogatz Model – Preferential Attachment Model – Price's Model -Link Analysis: Applications – Signed Networks – Strong and Weak ties – Link Analysis and Algorithms – Page Rank- PathSim

MODULE III COMMUNITY DETECTION AND LINK PREDICTION   **9**

Applications of community detection – Types of communities – Community Detection Methods – Disjoint Community Detection: Node centric, Modularity and Community Detection – Overlapping Community Detection: Clique Percolation, Link Partition – Link Prediction – Problem Definition – Problems of Link Prediction Evaluation – Supervised Random Walk

MODULE IV CASCADING BEHAVIOURS AND ANOMALY DETECTION   **10**

Preliminaries - Cascade Models: Decision Based Models, Multiple Choice Decision Based Model - Epidemic Models: SEIR Model, SIR Model, SIS Model, Analyzing Rumor Spread Spread – SEIZ Model-Cascade Prediction: DeepCAS- DeepHawkes Anomaly Detection: Anomaly Detection in Static Networks-Anomaly Detection in Dynamic Networks – Feature Based Approaches – Community Based Approaches

MODULE V GRAPH REPRESENTATION LEARNING AND CASE STUDIES   **8**

Criterion of GRL – GRL Pipeline – Representation learning methods- Matrix Factorization -Graph Convolution Network – GraphSAGE – Case Studies – Malicious Activities in OSNs – Sockpuppets in OSNs – Modeling the spread of COVID-19

COURSE OUTCOMES

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

CO1: Describe the importance, representation and the measures used in social network analysis

CO2: Apply analytical models for the construction of networks and link analysis

CO3: Develop models to perform link prediction from social networks.

CO4: Analyze the social networks using various models to perform community detection and detection of cascading behaviors

CO5: Develop predictive models for anomaly detection in social networks

CO6: Develop models using Graph Representation learning for social network analysis.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tanmoy Chakraborty,"Social Network Analysis", Wiley India, 2021.

REFERENCES:

1. Stanley Wasserman, Katherine Faust, "Social network analysis: methods and Applications", Cambridge University Press, 1999(Reprint).
2. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2	2			2						3		2
2	2	3	3	3	3	3						3		2
3	2	3	3	3	3	3						3		2
4	2	3	3	3	3	3						3		2
5	2	3	3	3	3	3						3		2
6	2	3	3	3	3	3						3		2
AVg.	2	3	3	3	3	3						3		2

1-low, 2-medium, 3-high

COURSE CODE	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

MODULE I TEXT PROCESSING AND N-GRAM MODELS   **9**

Introduction - Regular Expressions – Words – Corpora-Text Normalization-Minimum Edit Distance-N-Grams-Evaluating Language Models-Generalization and Zeros-Smoothing: Laplace Smoothing – Add-K smoothing -Backoff and Interpolation-Kneser-Ney Smoothing-The Web and Stupid Backoff

MODULE II VECTOR SEMANTICS AND PARTS OF SPEECH TAGGING   **9**

Lexical Semantics - Vector Semantics - Words and Vectors - Cosine for measuring similarity - TF-IDF: Weighing terms in the vector -Applications of the tf-idf vector model - Word2vec - Semantic properties of embeddings -Bias and Embeddings -(Mostly) English Word Classes - -Part-of-Speech Tagging-HMM Part-of-Speech Tagging: Markov Chains – Hidden Markov Model-Components of HMM Tagger-The Viterbi algorithm-Beam Search-Part-of-Speech Tagging for Other Languages

MODULE III FORMAL GRAMMARS, SYNTACTIC AND SEMANTIC PARSING   **9**

Constituency - Context-Free Grammars - Grammar Rules for English – Treebanks - Grammar Equivalence and Normal Form - Lexicalized Grammars - Ambiguity -CKY Parsing: A Dynamic Programming Approach - Partial Parsing – Semantic Parsing

MODULE IV DEPENDENCY PARSING AND INFORMATION EXTRACTION   **9**

Dependency Relations - Dependency Formalisms - Dependency Treebanks - Transition-Based Dependency Parsing - Graph-Based Dependency Parsing - Named Entity Recognition - Relation Extraction - Extracting Times - Extracting Events and their Times

MODULE V NEURAL MODELS FOR NLP AND SEQUENCE PROCESSING   **9**

The XOR problem - Feed-Forward Neural Networks- Training Neural Nets - Neural Language Models - Simple Recurrent Networks: Inference-Training -Unrolled networks as computational graphs- Applications of RNNs - Deep Networks: Stacked RNNs - Bidirectional RNNs - Managing Context in RNNs-Long Short-Term Memory- Gated Recurrent Units- Words, Characters and Byte-Pairs

COURSE OUTCOMES

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

CO1: Extract information from natural languages using text processing techniques and N-gram models.

CO2: Demonstrate vector semantics for the given language using appropriate language models

CO3: Apply Part-of-Speech tagging for the given language using various methods.

CO4: Develop parsing techniques to process the text data in Natural language processing

CO5: Apply dependency parsing methods to extract the relationships in the language.

CO6: Apply deep learning models for natural language processing applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin. 2020. Speech and Language Processing. 3rd Edition

REFERENCES:

1. Christopher D. Manning and Hinrich Schütze. Foundations of Statistical Natural Language Processing. MIT Press,1999.
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana. Practical Natural Language Processing. O'Reilly, 2020.

3. Hobson Lane, Cole Howard, Hannes Hapke. Natural Language Processing in Action, 2019.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	3	3	3								3	1	2
2	1	3	3	3								3	1	2
3	1	3	3	3								3	1	2
4	1	3	3	3								3	1	2
5	1	3	3	3	2							3	1	2
6	1	3	3	3	3							3	1	2
AVg.	1	3	3	3	3							3	1	2

1-low, 2-medium, 3-high

COURSE CODE	WEB MINING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION AND MODELLING   9

Web Characteristics-The impact of the web on IR-IR Versus Web Search-Components of a Search engine-Taxonomy and Characterization of IR Models - Boolean Model - Vector Model – Term Weighting - Scoring and Ranking -Language Models - Set Theoretic Models – Probabilistic Models - Algebraic Models - Structured Text Retrieval Models – Models for Browsing

MODULE II INDEXING   9

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

MODULE III WEB CRAWLING AND SEARCHING   9

Basic Crawler Algorithm - Implementation Issues- Universal Crawlers · Focused Crawlers- Topical Crawlers-Search Engines: Centralized Architecture-Distributed Architecture-Ranking-Indices-Metasearchers- Searching using Hyperlinks: Web Query Languages – Dynamic Search and Software Agents

MODULE IV STRUCTURED DATA EXTRACTION   9

Data Rich Pages- HTML Mark-Up Encoding of Data Instances- Wrapper Induction- Instance-Based Wrapper Learning- Automatic Wrapper Generation- String Matching and Tree Matching- Multiple Alignment- Extraction Based on a Single List Page- Extraction Based on Multiple Pages

MODULE V WEB USAGE MINING   9

Data Collection and Pre-Processing- Data Modeling for Web Usage Mining- Discovery and Analysis of Web Usage Patterns-The Recommendation Problem – Content based Recommendation- Collaborative Filtering: K-Nearest Neighbor- Collaborative Filtering: Matrix Factorization- Query Log Mining

COURSE OUTCOMES

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

CO1: Describe the models used for information retrieval from the web

CO2: Demonstrate the operations used for indexing web information

CO3: Develop algorithms to perform web crawling

CO4: Develop algorithms to perform search operations on the web

CO5: Apply various techniques to extract information from structured files in web

CO6: Analyze the usage of web data with data mining models

TOTAL : 45 PERIODS

TEXT BOOKS:
1. Ricardo Baeza - Yates, Berthier Ribeiro - Neto, "Modern Information Retrieval: The concepts and Technology behind Search" (Introduction and Indexing) , Addison Wesley, Second Edition, 2011.

2. Bing Liu, " Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (DataCentric Systems and Applications)", Springer; 2nd Edition 2009

REFERENCES:
1. Anthony Scime, "Web Mining:: Applications and Techniques", IGI Publishing, 2011.
2. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", 2002.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	3	3	3								2	1	2
2	1	3	3	3								2	1	2
3	1	3	3	3								2	1	2
4	1	3	3	3								2	1	2
5	1	3	3	3								2	1	2
6	1	3	3	3	3							2	1	2
AVg.	1	3	3	3	3							2	1	2

1-low, 2-medium, 3-high

COURSE CODE	HEALTHCARE DATA ANALYTICS	L	T	P	C
		3	0	0	3

MODULE I HEALTH CARE DATA SOURCES AND APPLICATIONS   9

Introduction-Healthcare Data Sources and Basic Analytics-Advanced Data Analytics for Healthcare-Applications and Practical Systems for Healthcare-Electronic Health Records: Components of EHR-Coding Systems-International Classification of Diseases-Systematized Nomenclature of Medicine Clinical Terms (SNOMED-CT)-RxNorm--Diagnosis-Related Groups (DRG)- Digital Imaging and Communications in Medicine (DICOM)-Benefits and Challenges of EHR

MODULE II BIO MEDICAL IMAGE AND SIGNAL ANALYSIS   9

Biomedical Image Analysis: Biomedical Imaging Modalities- Object Detection- Image Segmentation-Image Registration- Feature Extraction- Biomedical Signal Analysis: Types of Biomedical Signals-ECG Signal Analysis- Denoising of Signals- Multivariate Biomedical Signal Analysis- Cross-Correlation Analysis

MODULE III GENOMIC DATA ANALYTICS   9

Genomic Data Generation- Methods and Standards for Genomic Data Analysis: Normalization and Quality Control - Differential Expression Detection - Clustering and Classification- Pathway and Gene Set Enrichment Analysis - Genome Sequencing Analysis- Discovery of Biomarker and Molecular Signatures- Genome-Wide Association Study (GWAS)- ClinicoGenomic Integration-Different Types of Integration

MODULE IV PREDICTION MODELS IN CLINICAL DATA   9

Basic Statistical Prediction Models: Linear Regression - Logistic Regression-Markov Random Fields-Survival Models: Basic Concepts - Nonparametric Survival Analysis-Kaplan–Meier Curve and Clinical Life Table-Mantel–Haenszel Test-Cox Proportional Hazards Model-The Basic Cox Model-Estimation of the Regression Parameters-Penalized Cox Models- Survival Trees-Evaluation Metrics-Validation

MODULE V PRACTICAL SYSTEMS FOR HEALTHCARE   9

Sensor Data Mining Applications: Intensive Care Data Mining – Sensor Data Mining in Operating Rooms -Chronic Disease and Wellness Management Analytics for Pervasive Health: Supporting Infrastructure and Technology- Activity Recognition- Behavioural Pattern Discovery- Continuous Monitoring -Assisted Living Clinical Decision Support Systems (CDSS): Types of CDSS – Diagnostic Decision Support – Human Intensive Techniques

COURSE OUTCOMES

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

CO1: Describe various sources of health care data representations and its standards

CO2: Apply appropriate techniques to extract information from biomedical images and signals.

CO3: Develop analytical models for biomedical signals.

CO4: Interpret genomic data in healthcare using genome analytic methods and tools.

CO5: Apply suitable predictive models for health care applications.

CO6: Develop analytical models for health care applications.

                                                                                    TOTAL : 45 PERIODS

TEXT BOOKS:

1. Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.

REFERENCES:

1. Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.
2. Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
3. Hui Jang, Eva K.Lee, "HealthCare Analysis : From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016.
4. Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, "Big Data Analytics in HealthCare", Springer, 2020.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2			2						3		2
2	2	3	3	3	3	3						3		2
3	2	3	3	3	3	3						3		2
4	2	3	3	3	3	3						3		2
5	2	3	3	3	3	3						3		2
6	2	3	3	3	3	3						3		2
AVg.	2	3	3	3	3	3						3		2

1-low, 2-medium, 3-high

CLOUD APPLICATIONS AND SERVICES VERTICAL

COURSE CODE	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION 9

Cloud computing at a glance: Vision of cloud computing - Defining a cloud- Cloud computing reference model- characteristics and benefits -Challenges - Historical Developments: Distributed systems-Virtualization- web 2.0- Service Oriented Computing- Utility -Oriented Computing- Building cloud computing environments.

MODULE II VIRTUALIZATION 9

Introduction-Characteristics of Virtualized Environments-Taxonomy of Virtualization Techniques-Virtualization and Cloud Computing-Pros and Cons of Virtualization - Technology Examples: Xen Para virtualization - VM ware Full virtualization - Microsoft hyper -V

MODULE III CLOUD COMPUTING ARCHITECTURE 9

Cloud reference model: Architecture, Infrastructure / Hardware as a service, Platform as a service-Software as a service, Types of cloud: Public clouds, Private clouds, Hybrid Cloud, Community Clouds-Economics of the Cloud-Open Challenges

MODULE IV CLOUD PLATFORMS IN INDUSTRY 9

Amazon web services: Compute services- Storage services- Communication services-additional services-Google App Engine: Architecture and core concepts- Application life cycle- cost model-
Microsoft Azure: Azure core concepts- SQL Azure- Windows Azure platform appliance.

MODULE V SECURITY IN THE CLOUD 9

Security Overview - Cloud Security Challenges and Risks - Software-as-a-Service Security - Security Governance - Risk Management.

Security Monitoring - Security Architecture Design - Data Security - Application Security - Virtual Machine Security - Identity Management and Access Control - Autonomic Security

COURSE OUTCOMES

At the end of the course, students will be able to
CO1 :   Recognize the need for cloud computing and state the services and building blocks of cloud computing environments.
CO2 :   Define and classify the virtualization and its techniques.
CO3 :   Illustrate the cloud architecture and discover the requirement in industries.
CO4 :   Understand the concepts of virtualization and virtual machines in industry and to explore the types of virtualization.
CO5   :   Analyze the major security challenges and privacy problems in the cloud and virtual environment.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010. (Security In The Cloud only)

REFERENCES:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, Reprint 2010.
3. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, Third Edition, 2012.
4. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3					3	2					3	3	3	
2	3	3		3	3							3			
3	3		3	2	3	3	2					3	3	3	
4	3	3			3							3	3		
5	3			3		3		3				3		3	
AVg.	3	3		3		3	3	3				3	3		

1-low, 2-medium, 3-high

COURSE CODE	VIRTUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO VIRTUALIZATION 9

Virtualization and cloud computing - Need of virtualization – Cost, Administration, Fast deployment, Reduce infrastructure cost – Limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Para virtualization -Types of Hypervisors

MODULE II SERVER AND DESKTOP VIRTUALIZATION 9

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization

MODULE III NETWORK VIRTUALIZATION 9

Introduction to Network Virtualization-Advantages-Functions -Tools for Network Virtualization - VLAN - WAN Architecture - WAN Virtualization

MODULE IV STORAGE VIRTUALIZATION 9

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID.

MODULE V VIRTUALIZATION TOOLS 9

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

COURSE OUTCOMES

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

CO1 : To Learn the basics and types of Virtualization.
CO2 : To understand the Hypervisors and its types.
CO3 : To understand the network virtualization and its services.
CO4 : To learn the storage virtualization techniques applied in cloud.
CO5 : To learn various real time virtualization platforms.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – Paperback – 1 July 2017. ISBN-13 : 978-0070683518
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011, ISBN: 978-0-470-88799-8.
3. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach,2006, ISBN-13 : 978-0849339318.
4. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress, 2005. ISBN-13 : 978-1590594957

REFERENCES:

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3			3							3	3		
2	3	2			3							3			
3	2	3	3		2	3	3					2		3	
4	2	2			3							3		3	
5	3	3			2							2	3		
AVg.	3	3			3	3	3					3	3	3	

1-low, 2-medium, 3-high

COURSE CODE	CLOUD NATIVE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

MODULE I FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT   9
Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design.

MODULE II NATIVE APP DEVELOPMENT USING JAVA   9
Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props

MODULE III HYBRID APP DEVELOPMENT   9
Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova

MODULE IV CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE   9
What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross- platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props.

MODULE V NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS   9
Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability

COURSE OUTCOMES
At the end of the course, students will be able to
CO1 : To learn development of native applications with basic GUI Components.
CO2 : To learn native application development with event handling using JAVA.
CO3 : To learn and develop hybrid applications with basic event handling.
CO4 : To learn cross platform applications with basic GUI and event handling.
CO5 : To learn non-functional characteristics of application development frameworks.
                                                                                  TOTAL : 45 PERIODS

TEXT BOOKS:

1. Head First Android Development, 3rd Edition, Dawn Griffiths, David Griffiths, O'Reilly Media, Inc., November 2021, ISBN: 9781492076476.
2. Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing, January 2019, ISBN-13- 978-1728995557.
3. Native Mobile Development by Shaun Lewis, Mike Dunn, November 2019, O'Reilly Media, Inc. ISBN: 9781492052876.
4. React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition, January 2019, ISBN-13, 978-1788991926.
5. Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras, January 2016, ISBN-13   978-1305105966.

REFERENCES:

1. Apache Cordova in Action, Raymond K. Camden, Manning. 2015, October 2015,ISBN 9781633430068.
2. Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition, October 2018, ISBN: 9781789538502
3. Apache Cordova 4 Programming, John M Wargo, 2015, ISBN-13: 978-9332557291.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3			3	-	-	-	-	-	-	3	3	2
2	3		3		2	-	-	-	-	-	-	3	3	2
3	3	3	3		2	-	-	-	-	-	-	3	3	2
4	3	3	3	3	3	-	-	-	-	-	-	3	3	2
5	3		3	3	3	-	-	-	-	-	-	3	3	2
AVg.	3	3	3	3	2.6	-	-	-	-	-	-	3	3	2

1-low, 2-medium, 3-high

COURSE CODE	VIRTUAL REALITY AND AUGMENTED REALITY	L	T	P	C
		3	0	0	3

MODULE I VIRTUAL REALITY INTRODUCTION   9

Introduction to Virtual Reality (VR): Fundamental Concept - Types of VR Technologies-Components of Virtual Reality: Input Devices: Trackers, Navigation, and Gesture Interfaces - Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays- Computing Architectures for VR

MODULE II VR MODELING   10

Geometric Modeling: Introduction - Virtual Object Shape - Object Visual Appearance, Kinematics Modeling: Homogeneous Transformation Matrices - Object Position- Transformation Invariants-Object Hierarchies - Viewing the Three - Dimensional World, Physical Modeling: Collision Detection - Surface Deformation - Force Computation - Force Smoothing and Mapping - Haptic Texturing - Behavior Modeling

MODULE III AUGMENTED REALITY   9

Introduction to Augmented Reality (AR), Difference between AR, VR and Mixed Reality(MR), The Relationship Between Augmented Reality and Other Technologies, Working of AR, AR Concepts-Ingredients of an Augmented Reality-Major Hardware Components for Augmented Reality Systems, Major Software Components For Augmented Reality Systems.

MODULE IV AUGMENTED REALITY DESIGN   9

Content Creation: Creating Visual Content, Creating Audio Content, Creating Content For Other Senses (Touch, Taste, Smell), Representation And Perceptual Issues Interaction- Mobile Augmented Reality: Introduction-Advantages and Disadvantages- Architectures.

MODULE V VR and AR APPLICATIONS   8

VR Applications: Introduction - Engineering - Entertainment - Science - Training.

AR Applications: Augmented Reality Applications Areas-Medical, Retail, Tourism and construction, Collaborative Augmented Reality, Applying Augmented Reality to a Problem, Evaluating Augmented Reality Applications,Example Augmented Reality Applications.

COURSE OUTCOMES

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

CO1 :   Outline the foundation of virtual reality components and Modeling.
CO2 :   Knowledge in concepts of augmented reality and its design.
CO3 :   Gain knowledge on the applications of VR and AR.

                                                                   TOTAL : 45 PERIODS

TEXT BOOKS:

1. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley, India, 2nd Edition, 2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann Publication, 1st Edition, 2013.

REFERENCES:

1. Alan Craig, William Sherman and Jeffrey Will," Developing Virtual Reality Applications, Foundations of Effective Design", Morgan Kaufmann Publication, 2009.
2. Steven M. LaValle , Virtual Reality, Cambridge University Press, 2016.
3. Jon Peddie, Augmented Reality-Where We Will All Live,Springer, 2017

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2		2				2	2		3	3	3	
2	3	3	3		3				3	3	3	3		3	
3	3	3	3		3				3	3	3	3	3		
4															
5															
AVg.	3	3	3		3				3	3	3	3	3	3	

1-low, 2-medium, 3-high

COURSE CODE	SEMANTIC WEB	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION 7

Today's Web - Transformation from Today's Web to the Semantic Web - Semantic Web Technologies - A Layered Approach - XML: Structuring -Namespaces - Addressing & Querying - Processing.

MODULE II RDF 9

Overview-Basic Elements of RDF-RDF Triples-Basic Syntax-Literal values-Fundamental Rules of RDF-Relationship between XML and RDF- Need for RDFS-Elements of RDFS

MODULE III OWL 10

Introduction- Using OWL to define classes: Localize Global Properties, Set Operators and Enumerations- Using OWL to define Properties: Property Characteristics-ontology Matching and Distributed Information-Three Faces of OWL

MODULE IV LOGIC AND INFERENCE RULES 10

Monotonic Rules - Relationships - Syntax - Semantics - Description Logic Programs (DLP) - SWRL – Non Monotonic Rules -Motivation and Syntax - Examples - Rule Markup Language (RuleML).

MODULE V APPLICATIONS OF SEMANTIC WEB 9

Swoogle- architecture, usage and examples of using Swoogle; FOAF – Explanation, Vocabulary – Creating FOAF documents, API to understand OWL ontology- JENA, Protege.

COURSE OUTCOMES

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

CO1 : Describe the fundamental concepts, advantages of semantic web and understand how this technology revolutionizes the World Wide Web and its uses.

CO2 : Understand the semantic relationships among the data elements using Resource Description Framework (RDF)

CO3 : Model domain knowledge as ontologies using standards such as XML, RDF and OWL and develop inference systems.

CO4 : Infer the knowledge to implement logic and Inference rules

CO5 : Analyse the use of semantic web technologies in web service applications using semantic web tools and services.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Grigoris Antoniou, Paul Groth, Frank Van Harmelen and Rinke Hoekstra, "A Semantic Web Primer", MIT Press, Third Edition, 2012. [Unit 1,4]
2. LiyangYu , "Introduction to the Semantic Web and Semantic web services" , Chapman & Hall/CRC, Taylor & Francis group, 2019. [Unit 2,3 and 5]

REFERENCES:

1. Michael C. Daconta, Leo J. Obrst, and Kevin T. Smith, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Fourth Edition, Wiley Publishing, 2003.

2. John Davies, Rudi Studer, and Paul Warren John, "Semantic Web Technologies: Trends and Research in Ontology-based Systems", Wiley and Son's, 2006.
3. John Davies, Dieter Fensel and Frank Van Harmelen, "Towards the Semantic Web: Ontology-Driven Knowledge Management", John Wiley and Sons, 2003.
4. Karin K.Breitman, Marco Antonio Casanova and Walter Truszkowski, "Semantic Web: Concepts, Technologies and Applications", Springer-Verlag London Ltd., 2007.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2			3								3		
2	3	3			3									3	
3	3	3	3		3										
4	3	3	3	3	2					3	3	3	3		
5	3	2	2	3	3					3		3		3	
AVg.	3	3	3	3	3					3	3	3	3	3	

1-low, 2-medium, 3-high

COURSE CODE	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION   9

Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design..

MODULE II THE GRAPHICAL USER INTERFACE & DESIGN PROCESS   9

GUI: Popularity of graphics-The concept of direct manipulation-Graphical system -Characteristics-Web user-Interface Popularity- Characteristics and Principles of User Interface.

Design process: Human Interaction with computers- Importance of Human Characteristics- Human Consideration- Human Interaction Speeds and Understanding Business Junctions.

MODULE III SCREEN DESIGNING   11

Design Goals- Screen Planning and Purpose- Organizing Screen Elements- Ordering of Screen Data and Content- Screen Navigation and Flow- Visually Pleasing Composition- Amount of Information- Focus and Emphasis- presenting Information Simply and Meaningfully- Information retrieval on web- Statistical Analysis -Technological considerations in Interface Design.

MODULE IV WINDOWS & COMPONENTS   9

Windows: New Navigation Schemes-Selection of Window-Selection of Devices Based on Screen Based Controls. Components: Text and Messages- Icons and Increases - Multimedia-Colors - Uses -Problems-Choosing colors.

MODULE V SOFTWARE TOOLS AND INTERACTION DEVICES   7

Specification Methods- Interface Building Tools- Keyboard and Function Keys- Pointing Devices Speech Recognition.

COURSE OUTCOMES

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

CO1 : Describe the importance and need for effective user-friendly Graphical User Interfaces (GUI)

CO2 : Understand the importance of Human Characteristics and Business Functions

CO3 : Understand the principles of good screen design

CO4 : Understand the characteristics and guidelines of Device-Based, Screen-Based Controls, Icons and Images

CO5 : Understand the different types of user-interface specification methods and interface building tools

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.
2. Ben Schneiderman, "Designing the User Interface", Sixth Edition, Pearson Education Asia, 2018.

REFERENCES:

1. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition,2004.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2									2	1		
2	2	2	2									2	1		
3	2	2	2		2							2	1		
4	2	2	2		2							2	1		
5	2	2	2		2							2	1		
AVg.	2	2	2		2							2	1		

1-low, 2-medium, 3-high

COURSE CODE	MOBILE COMPUTING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

Mobile Communication-Mobile Computing-Mobile Computing Architecture-Mobile Devices-Mobile System Networks- Introduction to Cellular Systems - Global System for Mobile Communication (GSM) - General Packet Radio Services and their architectures – Introduction to 3G,4G and 5G Architecture.

MODULE II   MOBILE IP NETWORK LAYER   9

Mobile IP overview - IP packet delivery - Agent Discovery registration - Tunnelling and Encapsulation - Route optimization - Reverse Tunnelling - IPv6 - IP Micro Mobility Support - Dynamic Host Configuration Protocol.

MODULE III   MOBILE TRANSPORT AND APPLICATION LAYER   9

Mobile TCP - Fast Retransmit / Fast Recovery - Transmission Timeout Freezing - Selective Retransmission - Transaction oriented TCP - TCP over 2.5/3G Wireless Networks. WAP Architecture: Datagram Protocol, Transport Security - Transaction Protocol - Session Protocol - Application Environment-WML - WML Script – Wireless Telephony Application

MODULE IV   DATA DISSEMINATION AND SYNCHRONIZATION   9

Data Delivery Mechanisms - Synchronization - Synchronization Software - Synchronization Protocol-SyncML - Synchronized Multimedia Markup Language (SMIL).

MODULE V   MOBILE APPLICATION DEVELOPMENT   9

Android OS: Google Android Platform – Android Application Architecture - Application Lifecycle - Development framework - Developing application for android - Application class - Android activities - Event Based Programming – Location Based Services – Resilient Programming Practices – Packaging and Deployment

COURSE OUTCOMES

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

CO1: Identify the strength, limitation of mobile networks and discuss the technologies for mobile communication.

CO2: Describe the basic working principle of Mobile IP and express different scenarios for performing mobile communication.

CO3: Analyze TCP variations for mobility support and discuss about WAP architecture

CO4: Explain different types of data dissemination and synchronization mechanisms for mobile computing.

CO5: Develop simple android mobile application using development tools.

                                                                                TOTAL: 45 PERIODS

TEXT BOOKS:

1.   Jochen Schiller, "Mobile Communications", Pearson Education India, Second Edition, 2008. - ISBN-13 - 978-8131724262

2.   Raj Kamal, "Mobile Computing", Oxford University Press, New Delhi, Third Edition2019.

3.   RetoMeier,"ProfessionalAndroid4ApplicationDevelopment", Wiley India Pvt Ltd, Third Edition, 2012 (Mobile Application Development)

REFERENCES:
1. Stojmenovic and Cacute,"Hand Book of Wireless Networks and Mobile Computing", Wiley, 2006.
2. Reza Behravanfon, " Mobile Computing Principles: Designing and Developing Mobile Applications with UML & XML", Cambridge University Press, 2004.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2										2	2	
2	3	2										2	2	
3	3	2	3	2								2	2	
4	3	2	3	2								2	2	
5	3	2	3	2	3							2	2	
AVg.	3	2	3	2	3							2	2	

1-low, 2-medium, 3-high

COURSE CODE	ADVANCED COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

Overview of data communication model – Internet Multicasting, NAT, VPN – Routing Algorithms – BGP, RIP, OSPF – Differentiated and Integrated Services.

MODULE II   HIGH SPEED NETWORKS   9
SONET, ATM – MPLS -Next generation Internet architectures, Green Communication Networks, and Data Center Networking.

MODULE III   9
Multimedia Networking - Overview on VPN networks -Overview on Wireless Networks and Mobile Networks: LAN, PAN, Sensor Networks- Mobile IP, Mobile TCP- IPv4 and IPv6.

MODULE IV   9
Software Defined Network -Comparison between SDN and traditional networks -SDN controller, Switch design, SDN Controller-Switch Protocols, Open Flow Protocol.

MODULE V   9
Network Function Virtualization -NFV Architecture, benefits and market drive- Virtualization concepts- Network Functions-NFV deployment in Cloud -Introduction and importance of Open stack and 5G Networks.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: Understand advanced concepts and next generation networks.
CO2: Study of   High speed networks in Multimedia Networks.
CO3: Analyze TCP/IP variants, network Algorithm's, Protocols and their functionalities.
CO4: Comprehend features of SDN and its application to next generation systems.
CO5: Analyze the performance of various server implementations and 5G.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Tanenbaum AS, Wetherall DJ. Computer Networks. Fifth edition, Pearson Education, Inc. 2011.

REFERENCES:
1. Douglas E Comer. Internet Working with TCP/IP Volume -1, Sixth Edition, Addison-Wesley Professional;2013.
2. Goransson P, Black C, Culver T. Software Defined Networks: a Comprehensive Approach. Morgan Kaufmann; 2014.
3. Chayapathi R, Hassan SF, Shah P. Network Functions Virtualization (NFV) with a Touch of SDN: Netw Fun Vir (NFV ePub_1. Addison-Wesley Professional; 2016 Nov 14.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	2		2		2						2	2	
2	1	2		2		2						2	2	
3	1	2	1	2	2	2						2	2	
4	1	2	1	2	2	2						2	2	
5	1	2		2	2	2						2	2	
AVg.	1	2		2	2	2						2	2	

1-low, 2-medium, 3-high

COURSE CODE	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO DIGITAL FORENSICS   9
Forensic Science- Digital Forensics- Digital Evidence- The Digital Forensic Process: The Identification Phase- The Collection Phase- The Examination Phase- The Analysis Phase- The Presentation Phase.

MODULE II   DIGITAL FORENSIC READINESS   9
Definition – Law Enforcement versus Enterprise Digital Forensic Readiness – A Rationale for Digital Forensic Readiness - Frameworks, Standards and Methodologies - Enterprise Digital Forensic Readiness.

MODULE III   iOS FORENSICS   9
The iOS Architecture- The iOS File System- iOS Platform and Hardware Security – Identifying Stored Data- iOS Acquisition and Forensic Approaches- Third Party Applications.

MODULE IV   ANDROID FORENSICS   9
Android OS – Android Security Model – Bypassing Security – Android logical data acquisition – Android Physical data Acquisition – JTAG and chip off forensic examinations – Third party applications and a real case study.

MODULE V   WINDOWS PHONE 8 FORENSICS   9
Windows Phone 7 versus Windows Phone 8 – Windows Phone 8 Internals- Windows Phone 8 Security Models- Windows Phone Logical Acquisition- JTAG and Physical Acquisition- Artifact Location and User Pin study

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: To understand basic digital forensics and techniques.
CO2: To understand how to be prepared for digital forensic readiness.
CO3: To understand and use forensics tools for iOS devices.
CO4: To understand and use forensics tools for Android devices.
CO5: To understand and use forensics tools for Windows Phone 8 devices.

TOTAL: 45 PERIODS

TEXT BOOKS:
   1. Soufiane Tahiri, "Mastering Mobile Forensics", Packt Publishing, First Edition, May 2016.
   2. Andre Arnes, "Digital Forensics", Wiley, First Edition, 2018

REFERENCES:
   1. Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.
   2. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	2	1	2								2	2	1
2	1	2	2	2								2	2	1
3	1	2	2	2	3							2	2	1
4	1	2	2	2	3							2	2	1
5	1	2	2	2	3							2	2	1
AVg.	1	2	2	2	3							2	2	1

1-low, 2-medium, 3-high

COURSE CODE	BLOCKCHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO BLOCKCHAIN   9
History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

MODULE II   INTRODUCTION TO CRYPTOCURRENCY   9
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

MODULE III   ETHEREUM   9
The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

MODULE 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.

MODULE V   ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS   9
Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: Understand the technology components of Blockchain and how it works behind the
         scenes.
CO2: Be aware of different approaches to developing decentralized applications.
CO3: Understand the Bitcoin and its limitations by comparing with other alternative coins.
CO4: Establish deep understanding of the Ethereum model, its consensus model and code execution.
CO5: Understand the architectural components of a Hyperledger and its development framework
CO6: Aware of the Alternative blockchains and emerging trends in blockchain.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization   and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.

REFERENCES:
1. ArshdeepBahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.
2. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O"Reilly, 2014.
3. Roger Wattenhofer, "The Science of the Blockchain" CreateSpace Independent Publishing, 2016.

4. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
5. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3	3	2	2	2						2	2	
2	2	3	3	2	2	2						2	2	
3	2	3	3	2	2	2						2	2	
4	2	3	3	2	2	2						2	2	
5	2	3	3	2	2	2						2	2	
AVg.	2	3	3	2	2	2						2	2	

1-low, 2-medium, 3-high

COURSE CODE	CYBER SECURITY	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO CYBERCRIME   9
Introduction - Cybercrime and Information Security - Who are Cybercriminals - Classifications of Cybercrimes - Cybercrime: The legal Perspectives and Indian Perspective - Cybercrime and the Indian ITA 2000 - A Global Perspective on Cybercrimes.

MODULE II   CYBER OFFENSES   9
How Criminals Plan Them: Introduction - How Criminals plan the Attack- Social Engineering - Cyber stalking - Cyber cafe and Cybercrimes - Botnets: The Fuel for Cybercrime - Attack Vector - Cloud Computing.

MODULE III   CYBERCRIME: MOBILE AND WIRELESS DEVICES   9
Introduction - Proliferation of Mobile and Wireless Devices - Trends in Mobility - Credit card Frauds in Mobile and Wireless Computing Era - Security Challenges Posed by Mobile Devices - Registry Settings for Mobile Devices - Authentication service Security - Attacks on Mobile/Cell Phones - Mobile Devices: Security Implications for Organizations - Organizational Measures for Handling Mobile Devices Security Issues - Organizational Security Policies as an Measures in Mobile Computing Era - Laptops.

MODULE IV   TOOLS AND METHODS USED IN CYBERCRIME   9
Introduction - Proxy Servers and Anonymizers - Phishing - Password Cracking - Keyloggers and Spywares - Virus and Worms - Trojan Horse and Backdoors – Steganography - DoS and DDoS Attacks - SQL Injection - Buffer Overflow.

MODULE V   CYBER SECURITY: ORGANIZATIONAL IMPLICATIONS   9
Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risk s and Perils for Organizations, Social Computing and the associated challenges for Organizations.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1 : To understand the basic concepts of cybercrimes and its regulations in Indian and Global
            Perspectives.
CO2 : To understand about the underlying knowledge related to criminology and cyber threats.
CO3 : Ablity to understand the security threats and implications posed by cybercrimes in
            mobile devices.
CO4 : Ablity to understand the tools and techniques used in mitigating the cyber-attacks.
CO5 : To understand the essence of challenges and implications posed by cyber crimes in
             organizational structure.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA..

REFERENCES:
1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan Hwa(john) Wu,J.David Irwin, CRC Press

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3				2						2	2	
2	2	3				2						2	2	
3	2	3	3		2	2						2	2	
4	2	3	3		2	2						2	2	
5	2	3	3		2	2						2	2	
AVg.	2	3	3		2	2						2	2	

1-low, 2-medium, 3-high

COURSE CODE	ETHICAL HACKING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO ETHICAL HACKING   9

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

MODULE II   SCANNING AND ENUMERATION   9

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

MODULE III   SYSTEM HACKING   9

Introduction to System Hacking – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Countermeasures – Escalating Privileges – Executing Applications – Keyloggers and Spyware- Rootkits - Steganography.

MODULE IV   FUNDAMENTALS OF PENETRATION TESTING   9

Introduction to Penetration Testing Methodologies – Penetration Testing- Initial Stages in Penetration Testing- Penetration Testing Risks- Penetration Testing by Third Parties – Duties of a Licensed Penetration Tester – Standards and Compliance- Introduction to Penetration Testing Planning and Scheduling- Purpose of a Test Plan – Penetration Testing Planning Phases.

MODULE V   VULNERABILITY ANALYSIS AND PENETRATION TESTING   9

ntroduction to Vulnerability Analysis – Vulnerability Classification – Vulnerability Assessment Phases- Tools –Introduction to External Penetration Testing – Steps for Conducting External Penetration Testing - Introduction to Internal Network Penetration Testing - Steps for Conducting Internal Network Penetration Testing.

COURSE OUTCOMES

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

CO1 : To understand the need of information security

CO2 : To gain knowledge about the various tools and techniques used in techniques scanning and enumeration.

CO3 : To understand about the various system hacking techniques

CO4 : To understand about the fundamental principles, methodologies and planning phases of a penetration testing.

CO5 : To understand about the vulnerability analysis and about the steps involved in conducting external and internal penetration testing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. EC-Council, "Ethical Hacking and Countermeasures: Attack Phases", Cengage Learning, 2010.
2. EC-Council, "Penetration Testing Procedures and Methodologies", Cengage Learning, 2011.

REFERENCES:

1. Jon Erickson, "Hacking, 2nd Edition: The Art of Exploitation", No Starch Press Inc., 2008.
2. RafayBoloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2014.

CO-PO & PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3				2						2	2		
2	2	3	3		2	2						2	2		
3	2	3	3		2	2						2	2		
4	2	3	3		2	2						2	2		
5	2	3	3		2	2						2	2		
AVg.	2	3	3		2	2						2	2		

1-low, 2-medium, 3-high

SOFTWARE PROCESS AND MANAGEMENT VERTICAL

COURSE CODE	SOFTWARE METRICS AND MEASUREMENT	L	T	P	C
		3	0	0	3

MODULE I   FUNDAMENTALS OF SOFTWARE MEASUREMENT   7

Measurement: Measurement in software engineering - scope of software metrics. Basics of Measurement: representational theory of measurement-measurement and models- measurement scales and scale types - nominal scale - ordinal scale- interval scale- ratio scale- absolute scale - meaningfulness in measurement.

MODULE II   GOAL BASED FRAMEWORK AND DATA COLLECTION   10

Classifying software measures - determining what to measure - software measurement validation. Empirical Investigation - Principles of empirical studies. Software metrics data collection: Defining good data, data collection for incident reports, how to collect data, reliability of data collection procedures. Analyzing software measurement data: Statistical Distributions and hypothesis testing, classical data analysis techniques, examples of simple analysis techniques, overview of statistical tests.

MODULE III   PRODUCT ATTRIBUTES MEASUREMENT   13

Measuring internal product attributes: size - properties of software size - code size - design size - requirements analysis and specification size - functional size measures and estimators. Measuring internal product attributes: structure - Aspects of structural measures - control flow structure of program units - design level attributes. Measuring external product attributes: modeling software quality - measuring aspects of quality - usability measures - security measures.

MODULE IV   QUALITY METRICS   7

Product quality metrics, In - process quality metrics - software maintenance metrics. In-process metrics for software testing: Test Progress S curve, Testing defect arrivals over time, Testing defect backlog over time.

MODULE V   SOFTWARE RELIABILITY MEASUREMENT   8

Basics of reliability theory- software reliability problem - parametric reliability growth models: Jelinski-Moranda Model, other models based on Jelinski Moranda, little wood model, littlewood-verrall model - the recalibration of software reliability growth predictions.

COURSE OUTCOMES

At the end of the course, students will be able to
CO1: Infer the representational theory of measurement, scales and various software metrics.
CO2: Analyze the software measures, data collection procedures and apply suitable data analysis techniques.
CO3: Outline the measures for various internal and external product attributes.
CO4: Illustrate the various metrics on Product quality, Process quality and Software Maintenance.
CO5: Describe software reliability problems and reliability models to measure software reliability.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Norman Fenton and James Bieman, "Software Metrics - A Rigorous & Practical Approach", CRC press, Third Edition, 2015.
2. Stephen H Kan, "Metrics and Models in Software Quality Engineering", Pearson Education, Second Indian Reprint, New Delhi, 2016. (In-process metrics for software testing)

REFERENCES:

1. Capers Jones, "Applied Software Measurement: Global Analysis of Productivity and Quality", McGraw Hill Publishing, Third Edition 2008.
2. International Function Point Users Group "IT Measurement - A Practical Advice from the Experts", Pearson Education, Asia, 2002

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2									2	2	1	1
2	2	3	3	3							2	2	1	1
3	2	2									2	2	1	1
4	2	3	2	2							2	2	1	1
5	2	3	3	3							2	2	1	1
AVg.	2	3	3	3							2	2	1	1

1-low, 2-medium, 3-high

COURSE CODE	SOFTWARE TESTING AND QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO TESTING AND TEST DESIGN STRATEGIES-I   9

Introduction to Testing as an Engineering Activity: The role of Process in Software Quality, Testing as a Process, Overview of Testing Maturity Model (TMM) - Testing Fundamentals: Basic Definitions, Software Testing Principles, Tester's Role in a Software Development Organization - Defects, Hypothesis and Test: Origins of Defect, Defect Classes, the defect Repository and Test Design.
Strategies and Methods for Test Case Design I: Test Case Design strategies -Black Box Approach to Test Case Design- Random Testing- Equivalence Class Partitioning- Boundary Value Analysis- Other Black Box Test Design Approaches- COTS-Black box Methods and TMM level 2 goals.

MODULE II   TEST DESIGN STRATEGIES-II   6
Strategies and methods for test case design II: White Box Approach to Test Case Design- Test Adequacy Criteria –Coverage and Control flow graphs - Covering Code Logic- Paths- Additional White Box Test Design Approaches: Data Flow, Loop Testing, Mutation Testing- White Box Testing Methods and the TMM.

MODULE III   LEVELS OF TESTING   13
Need for levels of testing - Unit Test : Functions, Procedures, Classes, and Methods as Units- Unit Test planning - Designing the Unit Tests - The Class as a Testable Unit and Special Considerations - Test Harness.
Integration test: Goals - Integration strategies for Procedures, Functions and Classes- Designing Integration Tests- Integration test Planning.
System test: Functional testing, Performance testing, Stress Testing, Configuration Testing, Security Testing, Recovery Testing-Regression Testing- Alpha, Beta, Acceptance Testing.
Testing Goals, Policies & Plans: Introductory concepts -Testing/Debugging goals & Policies - Test planning -Test Plan Components- Reporting test results -Role of three critical groups.
Reviews: Types of Reviews-Inspection - walkthroughs - Components of Review plan-Review Check List-Review Metrics.

MODULE IV   TESTING WEB APPLICATIONS   5
Testing Concepts for Web Apps- the Testing Process- Content Testing- User Interface Testing-Component Level Testing- Navigation Testing- Configuration Testing- Security Testing - Performance Testing.

MODULE V   SOFTWARE QUALITY ASSURANCE, STANDARDS AND PROCESS MODELS   12
Quality Concepts - Quality - Software Quality - Garvin's Quality Dimensions - McCall's Quality Factors - ISO 9126 Quality factors - - Cost of Quality - Achieving software Quality – SQA Infrastructure - CASE Tools for Software Quality
Software Quality Assurance: Elements of SQA - SQA tasks, Goals, Attributes & Metrics - Statistical SQA - Software Reliability - ISO 9000 Quality standard - SQA Plan Software process Improvements: The CMMI – The People CMM.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: Describe testing fundamentals, Testing principles, TMM levels and classify the defects.
CO2: Apply suitable Black box and White Box testing techniques and design Test cases in practice.
CO3: Illustrate the levels of Testing, Test Plans, Testing goals & policies and organize the reviews for practical applications.
CO4: Ability to test different types of Web Applications, understand security and performance aspects of

testing.

CO5: Outline Software Quality attributes Software Quality Assurance functions and Prepare Software Quality Assurance plans.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2010, Reprint.
2. Roger. S. Pressman "Software Engineering A Practitioner's Approach, 7e", McGraw Hill International Edition, 2014. (Testing Web Applications, Software Quality and Quality Assurance, Quality Standards and Process Models)
3. Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009 (CASE Tools form Software Quality, SQA Infrastructure)

REFERENCES:

1. Yogesh Singh, " Software Testing", Cambridge University Press, 2012
2. Kshirasagar Naik, Priyadhrshini Tripathy, "Software Testing and Quality Assurance", John wiley & sons Inc Publication, 2008
3. Nina S Godbole, " Software Quality Assurance-Principles and Practice", Narosa Publishing, Second Edition, 2016

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2									2	2	1	2
2	2	3	3	3							2	2	1	2
3	2	3	3	3				2			2	2	1	2
4	2	3	3	3							2	2	1	2
5	2	2			3		2	2			2	2	1	2
AVg.	2	3	3	3	3		2	2			2	2	1	2

1-low, 2-medium, 3-high

COURSE CODE	CUSTOMER RELATIONSHIP MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9

Most profitable Customer - CRM: Custom centered database, Managing campaigns, Evolution of marketing, Closed loop marketing, CRM architecture - Customer profitability - Customer acquisition - Cross selling - Customer retention - Customer segmentation.

MODULE II   BUILDING THE BUSINESS CASE   10

Introduction - Uncovering the needs for data mining - Defining the business value - The costs - Deploying Data mining for CRM: Introduction - Define the problem - Define the user - Define the data - Scope the project - Trial - Quality assurance – Education Launch - Continuation.

MODULE III   COLLECTING CUSTOMER DATA   8

Introduction - Three types of customer data - Collecting customer data - Connecting customer - Customer data and privacy - Privacy and data mining - Guidelines for privacy - Legal issues associated with data mining.

MODULE IV   SCORING YOUR CUSTOMER   8

Introduction - Process - Scoring architectures and configurations - Preparing the data - Integrating scoring with other applications - Optimizing the CRM process: Introduction - Improved customer profitability through optimization - Optimized CRM - Complete loop - Optimal CRM process - Optimization techniques.

MODULE V   OVERVIEW OF DATA MINING AND CRM TOOL MARKETS   10

Introduction - Data mining market place - Taxonomy of data mining tools - Tool assessment attributes and methodology - Tool evaluation - Data mining tool: WEKA -CRM tools - Next generation for CRM.

COURSE OUTCOMES

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

CO1: State the evolution of marketing and define CRM architecture explaining customer acquisition, retention and segmentation.

CO2: Describe the business value, its costs and deploying data mining for CRM.

CO3: Infer the type of collecting and connecting the customer data with proper guidelines for privacy.

CO4: Demonstrate the scoring process and apply the various CRM optimization techniques to optimize the CRM process in order to improve customer profitability.

CO5: Evaluate CRM tools using tool assessment and methodology to choose the appropriate tool for real time applications.

                                                                    TOTAL: 45 PERIODS

TEXT BOOKS:
1. Alex Berson, Stephen Smith, Kurt Thearling, "Building Data mining Applications for CRM", Tata McGraw Hill, Fifteenth Reprint, 2008.

2. Ian H.Witten ,Eibe Frank, Mark A.Hall, "Data Mining Practical Machine Learning Tools and Techniques", Morgan Kaufmann, Fourth Edition, 2016

REFERENCES:
1. Francis Buttle, Stan Maklan "Customer Relationship Management: Concepts and Technologies",

Routledge, Fourth Edition, 2019.

2. Roger J. Baran, Robert J. Galka, "CRM: The Foundation of Contemporary Marketing Strategy", S.Chand (G/L) & Company Ltd, Second Edition, 2017.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1										2	1	2
2	1	2										2	1	2
3	1	2	2	2				3				2	1	2
4	1	2	2	2								2	1	2
5	2	3	3	3	3							2	1	2
AVg.	1	2	2	2	3			3				2	1	2

1-low, 2-medium, 3-high

COURSE CODE	ENTERPRISE RESOURCE PLANNING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   9
Enterprise - An Overview - Introduction to ERP - Benefits of ERP - ERP and Related Technologies - Business Process Reengineering (BPR) - Data Warehousing - Data Mining -OLAP - SCM.

MODULE II   ERP IMPLEMENTATION   10
ERP Implementation Lifecycle - Implementation Methodologies - ERP deployment methods - Package Selection - Process Definition - Vendors and Consultants - Contract with Vendors, Consultants and Employees - Training and education- Project Management and Monitoring.

MODULE III   THE ERP BUSINESS MODULES   9
Business modules of an ERP Package - Finance - Manufacturing - Human Resources - Plant Maintenance - Materials Management - Quality Management - Sales and Distribution.

MODULE IV   THE ERP MARKET & ERP - Present and Future   9
ERP Marketplace and Marketplace Dynamics - ERP Vendors - SAP AG, Oracle Corporation, Microsoft Dynamics, EPICOR, QAD, RAMCO Systems - Enterprise Application Integration (EAI)- ERP and E-Business- Future Directions and Trends in ERP.

MODULE V   SAP   8
Gateway to SAP: Architecture of SAP R/3 -SAP Integrated-Three Tier Architecture - SAP Easy Access - Understanding ABAP Workbench.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: Describe the operational aspects of ERP systems and related technologies.
CO2: Illustrate the steps required for ERP Project management and implementation process by choosing the right vendors/consultants, employee training and monitoring.
CO3: Categorize the business modules of an ERP package in order to define the functionality of various departments in a company.
CO4: Analyze the ERP marketplace and its vendors, and assess how Enterprise Application Integration (EAI), e-business helps the company use ERP to its utmost benefit.
CO5: Infer the importance and role of SAP in scaling up enterprise access.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Alexis Leon, "ERP Demystified", Tata McGraw Hill, New Delhi, Third Edition, 2014.
2. Dreamtech Press, "SAP R/3, Black Book", Dreamtech Software Team, 2006 (SAP).

REFERENCES:
1. Ellen F.Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Course Technology Ptr, Fourth Edition, 2013.
2. Vinod Kumar Garg and Venkita krishnan N.K., "Enterprise Resource Planning - Concepts and Practice", Prentice Hall of India, New Delhi, Second Edition, 2012.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
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2	2	2									3	2	1	2
3	2	2										2	1	2
4	2	2				2		3			3	2	1	2
5	2	2				2		3			3	2	1	2
AVg.	2	2				2		3			3	2	1	2

1-low, 2-medium, 3-high

COURSE CODE	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION TO PROJECT MANAGEMENT   7

Introduction - Project attributes - Constraints - Project Stakeholders - Project Management knowledge areas - Project management tools and techniques - The Role of the Project Manager - Project Management Profession -PMI, Certification, ethics in Project Management - A systems view of Project Management - Systems Approach - Three sphere model for Systems Management - Understanding Organizations : Four frames of Organization - Organization structure and culture - Project Phases and the Project Life Cycle - Product Life cycles - waterfall - Spiral -prototyping - RAD - Agile models.
Recent Trends affecting Information Technology Management: Globalization - outsourcing - virtual teams and Agile Project Management.

MODULE II   PROJECT INTEGRATION MANAGEMENT   6

Strategic Planning and Project Selection -Strategic Planning - Identifying Potential Projects - Methods for selecting Projects - Net Present Value Analysis - Return on Investment - Payback Analysis - Weighted Scoring Model - Balanced Score Card - Developing Project Charter - Developing Project Management Plans - Monitoring and Controlling Project Work - Integrated Change Control - Closing Projects. Project Management Software and Tools: Gantt chart - Slip Chart - Time Line - Use of MS Project.

MODULE III   PROJECT SCOPE, TIME AND COST MANAGEMENT   9

Project scope management: Scope management plan -Collecting requirements - Defining Scope - Creating the work breakdown structure -WBS Dictionary - Scope Validation and Control.

Project time management: Importance of project schedules -Planning Schedule Management - Defining and sequencing Activities-Estimating activity resources and duration -Schedule development: Gantt chart, Critical Path Method (CPM), Critical Chain Scheduling, PERT - Controlling the Schedule.

Project cost management: Basic Principles -Planning Cost Management - Cost estimating - Types of cost estimates - cost estimation tools & Techniques - Cost budgeting - Cost control: Earned Value Management, Project Portfolio Management.

MODULE IV   PROJECT HUMAN RESOURCE AND COMMUNICATION MANAGEMENT   6

Human Resource Management: Importance of HR Management-Motivation Theories - Maslow's hierarchy of needs - Herzberg Theory - Developing the Human resource Plan - Project organizational charts - Responsibility Assignment Matrices - Developing the Project Team - Training - Team building - Rewards and Recognition- Tools and techniques for managing project Teams.
Project Communications Management: Keys to good Communications - Planning Communications Management - Managing and Improving project Communications.

MODULE V   RISK AND QUALITY MANAGEMENT   9

Project Risk management: Planning Risk Management - Common sources of risk -Identifying - quantitative risk analysis - qualitative risk analysis - planning risk responses-Controlling risks.
Project Quality Management: Importance of quality management - Planning quality management - Performing quality Assurance -   Controlling quality - Tools and Techniques for quality control -Six Sigma concepts - cost of quality.

COURSE OUTCOMES

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

CO1: Describe project management knowledge areas, project management tools and techniques and identify suitable process models.

CO2: Outline the project schedules, project monitoring tasks and practice the use of project management tools.

CO3: Construct the work break down structure, time estimation and cost management of the project using PERT, CPM and Earned Value methods.

CO4: Apply the principles and practices of human resource and communication management in delivering quality products.

CO5: Identify and analyze the project risks, device risk management strategies and apply quality control and quality assurance techniques.

CO6: Describe the project procurement management process, project implementation, and project closure and evaluation activities.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Kathy Schwalbe, "Information Technology Project Management", Cengage Learning India Private Limited, New Delhi, Nineth Edition, 2019.

2. Jack T.Marchewka, "Information Technology Project Management - Providing Measurable Organizational Value", Wiley Publication, Fifth Edition,2015.(Project Completion)

REFERENCES:
1. Subramaniam Chandramouli, Saikat Dutt, "Software Project Management" Pearson Education, First Edition 2015.
2. Bob Hughes, Mike Cotterell, "Software Project Management", Sixth Edition, Tata McGraw Hill, 2017.

CO-PO & PSO MAPPING

CO	PO												PSO	
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1	1	2			3						3	2	1	2
2	1	3		2							3	2	1	2
3	1	3	3	2							3	2	1	2
4	1	3		2			2	3			3	2	1	2
5	1	3	3	2	3						3	2	1	2
6	1	2									3	2	1	2
AVg.	1	3	3	2	3		2	3			3	2	1	2

1-low, 2-medium, 3-high

COURSE CODE	AGILE TECHNOLOGY	L	T	P	C
		3	0	0	3

MODULE 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.

MODULE II AGILE PROCESSES   9
Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

MODULE 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).

MODULE 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.

MODULE 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 Global Software Development.

COURSE OUTCOMES
At the end of the course, students will be able to
CO1: Compare the traditional model with agile model and explain the basic concepts of agile methodology.
CO2: Examine various agile processes and choose the suitable agile model to develop software products.
CO3: Plan and execute the iterative software development process based on knowledge management.
CO4: Make use of agile practices in requirement engineering to assess the various requirements of the stakeholders.
CO5: Apply agile metrics and techniques for improving the quality of the software process and product development.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. David J. Anderson and Eli Schragenheim — Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. Orit Hazzan and Yael Dubinsky, — Agile Software Engineering, Series: Undergraduate Topics in

Computer Science, Springer, 2009

REFERENCES:
1. Craig Larman, — Agile and Iterative Development: A Manager's Guide, Addison-Wesley, 2004.

2. Kevin C. Desouza, — Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2										2	1	2
2	2	3		3								2	1	2
3	2	3	2	3							2	2	1	2
4	2	3						3			2	2	1	2
5	2	3										2	1	2
AVg.	2	3	2	3				3			2	2	1	2

1-low, 2-medium, 3-high

DATA SCIENCE VERTICAL (MINOR)

COURSE CODE	DATABASE SYSTEMS	L	T	P	C
		3	0	0	3

MODULE I   RELATIONAL DATABASE   10

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

MODULE II   DATABASE DESIGN   8

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

MODULE III   TRANSACTIONS   9

Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking

MODULE IV IMPLEMENTATION TECHNIQUES   9

RAID – File Organization – Organization of Records in Files – Data dictionary Storage – Column Oriented Storage– Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview.

MODULE V   ADVANCED TOPICS   9

Distributed Databases: Architecture, Data Storage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. Database Security: Security issues – Access control based on privileges – Role Based access control – SQL Injection – Statistical Database security – Flow control – Encryption and Public Key infrastructures – Challenges.

COURSE OUTCOMES

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

CO1: Describe fundamental elements of relational database management systems

CO2: Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL

CO3: Describe a concise overview of database design by normalization.

CO4: Construct queries to handle transaction processing and maintain consistency of the database

CO5: Compare and contrast various indexing strategies and apply the knowledge to tune the performance of the database

CO6: Appraise how advanced databases differ from Relational Databases and find a suitable database for the given requirement.

                                                                        TOTAL : 45 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2021.
2. 2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006..

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1									2		
2	2	3	3	3	2							2		
3	2	3	3	3	2							2		
4	2	3	3	3	2							2		
5	2	3	3	3	2							2		
AVg.	2	3	3	3	2							2		

1-low, 2-medium, 3-high

COURSE CODE	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

MODULE I   DATA, ARRAYS, LINKED LIST AND ALGORITHM ANALYSIS   10

Data Vs Information - Definition of an Algorithm - Basic Steps in Development of an Algorithm - Algorithm Complexity - Space and Time Complexity - Order Notations-Definition, Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT

MODULE II   STACKS AND QUEUES   9

Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues.

MODULE III   TREES   9

Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Priority Queue (Heaps) – Binary Heap, B-Tree – B+ Tree.

MODULE IV GRAPHS   9

Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal – Depth-first traversal –– Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm.

MODULE V   SORTING AND SEARCHING   8

Sorting: Bubble sort – Selection sort – Insertion sort – Shell sort –. Merge Sort - Searching : Linear Search – Binary Search – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing.

COURSE OUTCOMES

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

CO1: Implement programs using linked lists and arrays.

CO2 : Analyze the time and space complexity for algorithms

CO3: Develop programs using stack and queue ADTs.

CO4 : Implement Tree data structure and its operations.

CO5 :Apply appropriate graph traversal algorithms for a given application.

CO6: Implement appropriate searching, sorting and hashing techniques for the given application.

                                        TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. 2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
2. Tremblay JP, Sorenson PG. An introduction to data structures with applications. Second Edition, McGraw-Hill; 2002.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1									2		
2	2	3	3	3								2		
3	2	3	3	3								2		
4	2	3	3	3								2		
5	2	3	3	3								2		
AVg.	2	3	3	3								2		

1-low, 2-medium, 3-high

COURSE CODE	STATISTICS FOR DATA SCIENCE	L	T	P	C
		3	0	0	3

MODULE I   SUMMARIZING DATA   8

Introduction-Need for Statistics - Descriptive and Inferential Statistics - Describing data with averages - Describing Variability - Normal Distribution and Standard (z) scores-Relationships among Data: Correlation- Regression.

MODULE II   INFERENTIAL STATISTICS   8

Introduction to Hypothesis Testing (Z test)-Need for hypothesis testing - Confidence Intervals - t Test for one sample - One factor Analysis of Variance- Two sources of variability - f test-One variable chi-square test- two variable- chi-square test.

MODULE III   DATA MINING, DATA PREPROCESSING AND DATA WAREHOUSE   11

Data Mining: Kind of Data - Data Patterns - Targeted Applications - Major Issues in Data Mining - Data Objects and Attribute types - Basic Statistical Descriptions of Data: Measuring the Central Tendency - Measuring the Dispersion of Data

Data Preprocessing: An Overview - Major tasks in data pre-processing - Data Cleaning- Data Integration - Data Reduction: Principal Component Analysis - Attribute subset selection –- Data Transformation by normalization.

Data Warehouse: Basic concepts, Data Cube and OLAP.

MODULE IV ASSOCIATION RULE MINING AND CLUSTERING   9

Definition - Apriori Algorithm - Generation of Association Rules from Frequent Itemsets.

Cluster analysis - Types of data -Requirements for cluster analysis - Categorization of major clustering methods – Partitioning: K-Means algorithm - Hierarchical Method: BIRCH - Density based clustering: DBSCAN.

MODULE V   CLASSIFICATION   9

Classification: Decision tree induction : Attribute selection measures - Tree Pruning – Bayesian Classification: Naïve Bayesian Classification - Support Vector Machines

COURSE OUTCOMES

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

CO1: Interpret the data and the relationships existing between the data.

CO2: Infer the conclusion about the population using statistical testing techniques.

CO3: Discuss the mining and pre-processing of various complex data types to solve the real world problems.

CO4: Apply association rules mining for data analysis.

CO5: Apply clustering techniques for data analysis.

CO6: Analyse the different types of data using classification algorithms

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Robert S.Witte, John S.Witte, "Statistics", Eleventh Edition, - Wiley Publications, 2017(For Data Summarization and Inferential Statistics)

2. Jiawei Han &Micheline Kamber, "Data Mining-Concepts and Techniques" Morgan Kaufmann Publishers, Fourth Edition, 2022.

REFERENCES:

1. Dunham, "Data Mining- Introductory and Advanced Topics", Pearson Education, New Delhi, First Edition, 2006.
2. Pieter Adriaans, DolfZantinge, "Data Mining ", Pearson Education, Delhi,Third Edition, 2009.
3. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World ", Pearson Education,Seventhindian Reprint New Delhi,2003.
4. George M. Marakas, " Modern Data Warehousing, Mining, & Visualization Core concepts", Pearson Education, First Edition, 2003
5. Paulraj Ponnaiah, "Data Warehousing Fundamentals", Wiley Publishers, Singapore, First Edition, 2001.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1									2		
2	2	3	3	3								2		
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5	2	3	3	3								2		
AVg.	2	3	3	3								2		

1-low, 2-medium, 3-high

COURSE CODE	APPLIED DATA SCIENCE USING PYTHON	L	T	P	C
		3	0	0	3

MODULE I BASIC PYTHON,IPYTHON 9

Essential Python Libraries-Built-in Data structures-Functions-Files-Launching Shell and Notebook-Help and Documentation-Keyboard Shortcuts in Ipython shell-Ipython Magic Commands-Input and Output History-Ipython and Shell Commands.

MODULE II INTRODUCTION TO NUMPY 9

Understanding Data Types in Python-The Basics of NumPy Arrays-Computation on NumPy Arrays: Universal Functions-Aggregations: Min, Max, and Everything In Between-Computation on Arrays: Broadcasting-Comparisons, Masks, and Boolean Logic-Fancy Indexing-Sorting Arrays-Structured Data: NumPy's Structured Arrays

MODULE III DATA MANIPULATION WITH PANDAS 9

Introducing Pandas Objects - Data Indexing and Selection - Operating on Data in Pandas - Handling Missing Data - Hierarchical Indexing - Combining Datasets: Concat and Append - Combining Datasets: Merge and Join -Aggregation and Grouping - Pivot Tables -Vectorized String Operations

MODULE IV VISUALIZATION WITH MATPLOTLIB 9

Simple Line Plots-Simple Scatter Plots-Visualizing Errors-Density and Contour Plots-Histograms, Binnings, and Density-Customizing Plot Legends-Customizing Colorbars-Multiple Subplots-Text and Annotation-Three-Dimensional Plotting in Matplotlib.

MODULE V MACHINE LEARNING 9

Introducing Scikit-Learn-Hyperparameters and Model Validation-Feature Engineering-In Depth: Naive Bayes Classification-Linear Regression-Support Vector Machines-Decision Trees and Random Forests-k-Means Clustering

COURSE OUTCOMES

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

CO1: Practice programs using basic python commands
CO2 : Implement python programs using Numpy API
CO3: Demonstrate data manipulation using Pandas framework
CO4 : Apply Matplotlib API to visualize the data using appropriate charts
CO5 : Demonstrate the training of machine learning models using scikit.
CO6: Implement real time machine learning algorithms in Python.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Jake VanderPlas," Python Data Science Handbook: Essential Tools For Working With Data",2016
2. Wes McKinney ,"Python for Data Analysis - Data Wrangling with Pandas, NumPy, and IPython", O'Reilly ,Second Edition 2017..

REFERENCES:

1. David Beazley and Brian K. Jones ,"Python Cookbook", O'Reilly,Third Edition,2013.

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
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AVg.	2	3	3	3								2		

1-low, 2-medium, 3-high

COURSE CODE	APPLIED MACHINE LEARNING	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION AND PARAMETERS OF SUPERVISED LEARNING   9

Introduction – Well posed Machine learning problems – Data Representation – Forms of learning – Learning from Observations – Occam's Razor principle and Overfitting Avoidance- Heuristic Search in Inductive Learning – Estimating Generalization Errors – Metrics for Assessing Regression and Classification

MODULE II   SUPERVISED LEARNING - CLASSIFICATION   11

Bayesian Reasoning: Bayes Theorem, Naïve Bayes Classifier – k-Nearest Neighbour classifier – Support Vector Machine: Linear Discriminant function for classification – Linear Maximal Margin Classifier – Linear Soft Margin Classifier- Kernel Induced Feature spaces – Non-linear classifier - Decision Tree Classifier

MODULE III   SUPERVISED LEARNING - REGRESSION   8

Discriminant Functions and Regression Functions – Numeric Prediction and Regression Functions – Linear Regression with Least Square Error Criterion – Logistic Regression – Regression by Support Vector Machines

MODULE IV SUPERVISED LEARNING – NEURAL NETWORKS   9

Towards Cognitive Machine - Neuron Models - Network Architectures – Perceptron - Linear Neuron and the Widrow-Hoff Learning Rule - The Error-Correction Delta Rule - Multi-Layer Perceptron (MLP) Networks and the Error-Backpropagation Algorithm - Multi-Class Discrimination with MLP Networks - Radial Basis Functions (RBF) Networks.

MODULE V   UNSUPERVISED LEARNING   8

Clustering - Engineering the Data – Basic Clustering methods - K-Means Clustering - Fuzzy K-Means Clustering - EM Algorithm – Case studies on ML for Health Care and Agriculture

COURSE OUTCOMES

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

CO1: Explain the types of machine learning model, parameters to be considered for developing a supervised machine learning model

CO2: Apply supervised machine learning models to perform classification

CO3: Apply supervised machine learning models to perform regression

CO4: Apply Neural Network models to perform classification and regression

CO5: Apply unsupervised machine learning models to perform clustering

CO6: Implement machine learning algorithms for real world problems.

                                                                                      TOTAL : 45 PERIODS

TEXT BOOKS:

1. M. Gopal, "Applied Machine Learning", McGraw-Hill, First Edition, 2019.

REFERENCES:

1. Hastie, Tibshirani, and Friedman,, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, Second Edition, 2016.
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware / Software Interface", Morgan Kaufmann, Sixth Edition, 2021.

3. John P. Hayes, "Computer Architecture and Organization", McGraw Hill, Third Edition,2017

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CO-PO & PSO MAPPING

CO	PO												PSO	
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5	2	3	3	3								2		
AVg.	2	3	3	3								2		

1-low, 2-medium, 3-high

COURSE CODE	DATA VISUALIZATION	L	T	P	C
		3	0	0	3

MODULE I   INTRODUCTION   **9**

Introduction to Visualization – Stages- Usage –Types of Charts- Visualization Best Practices: Data types- Estimation- Design Principles

MODULE II   VISUALIZATION OF STRUCTURED DATA   **9**

Exploratory Analysis- Multivariate Analysis- Modelling- Visualization- Business Operations Dashboard

MODULE III   VISUALIZATION OF UNSTRUCTURED DATA   **9**

Text data visualization – Forms- Preprocessing- Visualizing Text Data- Visualizing Conversations

MODULE IV INFORMATION DASHBOARD DESIGN   **9**

Introduction, Dashboard design issues and assessment of needs, Considerations for designing dashboard-visual perception, Achieving eloquence, Advantages of Graphics _Library of Graphs, Designing Bullet Graphs, Designing Sparklines, Dashboard Display Media, Critical Design Practices, Putting it all together - Unveiling the dashboard.

MODULE V   DATA VISUALIZATION TOOLS   **9**

Tableau- Dundas BI- JupyteR- Zoho Reports- Google Charts- IBM Cognos – Case studies

COURSE OUTCOMES

At the end of the course, students will be able to
   CO1 : Use python libraries for data visualization
   CO2: Conduct exploratory data analysis using Python
   CO3 : Interpret results of exploratory data analysis
   CO4 : Paraphrase the results for documentation
   CO5 : Design information dashboard.

                                                                                                    TOTAL : 45 PERIODS

TEXT BOOKS:
   1.   Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
   2.   Sharadha Sringeshwara, Purvi Tiwari, U.Dinesh Kumar, "Data Visualization", Wiley, First Edition, 2022.

REFERENCES:
   1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
   2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
   3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
   4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
   5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
   6. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014
   7. https://www.simplilearn.com/data-visualization-tools-article (Vth Unit)

CO-PO & PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1									2		
2	2	3	3	3								2		
3	2	3	3	3								2		
4	2	3	3	3								2		
5	2	3	3	3								2		
AVg.	2	3	3	3								2		

1-low, 2-medium, 3-high

COURSE CODE	DATA ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I   DATA ENGINEERING DESCRIBED FOUNDATION AND BUILDING BLOCKS   **9**

Data Engineering Described : Data Engineering Defined - The Data Engineering Lifecycle- Evolution of the Data Engineer -Data Engineering and Data Science. Data Engineering Skills and Activities: Data Maturity and the Data Engineer -The Background and Skills of a Data Engineer - Business Responsibilities - Technical Responsibilities- The Continuum of Data Engineering Roles, from A to B Data Engineering Lifecycle : Data Engineering Lifecycle - The Data Lifecycle Versus the Data Engineering Lifecycle : Generation: Source Systems - Storage - Ingestion - Transformation - Serving Data -Data Management - DataOps - Data Architecture - Orchestration - Software Engineering.

MODULE II   DESIGNING GOOD DATA ARCHITECTURE   **9**

Enterprise Architecture Defined -Data Architecture Defined - Principles of Good Data Architecture : Choose Common Components Wisely Plan for Failure - Architect for Scalability - Architecture Is Leadership : Build Loosely Coupled Systems - Make Reversible Decisions - Prioritize Security - Embrace FinOps - Major Architecture Concepts : Domains and Services - Distributed Systems, Scalability, and Designing for Failure - Tight Versus Loose Coupling: Tiers, Monoliths, and Micro services - User Access: Single Versus Multitenant - Event-Driven Architecture - Brownfield Versus Greenfield Projects :Examples and Types of Data Architecture - Data Warehouse - Data Lake - Lambda Architecture

MODULE III   TECHNOLOGIES ACROSS THE DATA ENGINEERING   **9**

Interoperability - Cost Optimization and Business Value : Total Cost of Ownership -Total Opportunity Cost of Ownership - FinOps - Location : On Premises - Cloud - Hybrid Cloud - Multicloud -Decentralized: Blockchain and the Edge- Build Versus Buy: Open Source Software - Proprietary Walled Gardens. Monolith Versus Modular : Monolith - Modularity - The Distributed Monolith Pattern .Serverless Versus Servers: Serverless -Containers - Evaluate Server Versus Serverless. Data Engineering Storage Abstractions : The Data Warehouse - The Data Lake - The Data Lakehouse - Data Platforms

MODULE IV QUERIES, MODELING, AND TRANSFORMATION   **9**

Queries - The Life of a Query - The Query Optimizer -Improving Query Performance - Queries on Streaming Data. Data Modeling : Data Model - Conceptual, Logical, and Physical Data Models - Normalization - Techniques for Modeling Batch Analytical Data - Modeling Streaming Data. Transformations :Batch Transformations - Materialized Views, Federation, and Query Virtualization - Streaming Transformations and Processing.

MODULE V   Security, Privacy, and the Future of Data Engineering   **9**

Security and Privacy : People - The Power of Negative Thinking - Always Be Paranoid Processes - Security Theater Versus Security Habit - Active Security - The Principle of Least Privilege - Shared Responsibility in the Cloud - Always Back Up Your Data. Security Policy - Technology - Patch and Update Systems - Encryption - Logging, Monitoring, and Alerting - Network Access - Security for Low-Level Data Engineering.

COURSE OUTCOMES

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

CO1 : Describe a concise overview of the entire data engineering landscape

CO2 : Learn to use the data engineering lifecycle to design and build a robust architecture

CO3: Assess data engineering problems using an end-to-end framework of best practices

CO4: Illustrate Cut through marketing hype when choosing data technologies, architecture, and processes

CO5 : Incorporate data governance and security across the data engineering lifecycle

CO6 : Design, implement, and evaluate the use of data analytic algorithms on sample datasets.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Reis, Joe, and Matt Housley. Fundamentals of Data Engineering: Plan and Build Robust Data Systems. O'Reilly Media, 2022.
2. Crickard, Paul, Data Engineering With Python: Work With Massive Datasets to Design Data Models and Automate Data Pipelines Using Python. Packt Publishing Ltd, 2020.

REFERENCES:

1. Haines, Scott. *Modern Data Engineering With Apache Spark: A Hands-On Guide for Building Mission-Critical Streaming Applications.* Apress, 2022.

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CO-PO & PSO MAPPING

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4	2	3	3	3								2		
5	2	3	3	3								2		
AVg.	2	3	3	3								2		

1-low, 2-medium, 3-high