NANDHA ENGINEERING COLLEGE

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

Curriculum and Syllabi

for

M.E –Computer Science and Engineering [R22]

[CHOICE BASED CREDIT SYSTEM]

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

AUGUST 2022

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

M.E – COMPUTER SCIENCE AND ENGINEERING	
VISION	To emerge as an eminent department in providing quality professionals, researchers, entrepreneurs with software skills and ethical values to cater to the changing needs of the industry and society.
MISSION	• To provide quality education to produce ethically strong Computer Science professionals with social responsibility • To impart the necessary domain skills to excel in solving real world problems. • To create a learner centric platform with ongoing development to fulfill the global computing demands.
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	The post graduates of Computer Science and Engineering will be **PEO 1:** Demonstrate an exceptional involvement in adopting advanced techniques and tools to build solutions for the problems identified. **PEO 2:** Exhibit leadership skills as an individual or in a team through demonstration of good analytical research, design and implementation skills and contribute towards societal growth. **PEO 3:** Pursue life-long learning to fulfill career goals and upgrade knowledge on the recent technologies for attaining professional and entrepreneurship excellence.
PROGRAMME SPECIFIC OUTCOMES (PSO)	The students of post graduates Computer Science and Engineering will be able to **PSO 1:** Ability to be a technically competent employee, researcher, entrepreneur and excel in providing socially acceptable solutions to real world problems by applying emerging technology in the area of computer science and engineering. **PSO 2:** Ability to work as part of teams on multidisciplinary projects and diverse environments and pursue lifelong professional development in computer domain.

PROGRAM OUTCOMES:

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

a-f	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
a	Research Aptitude	**PO1**	An ability to independently carry out research / investigation, identify problems and develop solutions to solve practical problems.
b	Technical Documentation	**PO2**	An ability to write and present a substantial technical report / document.
c	Technical competence	**PO3**	Student should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
d	Handle complex problems	**PO4**	Use research based knowledge, method, appropriate techniques, resources and tools to solve complex engineering issues with an understanding of the limitations.
e	Environmental Sustainability and societal ethics	**PO5**	Ensure development of socially relevant and eco-friendly indigenous products by applying technical knowledge, ethical principles and, sound engineering practices.
f	Life-long learning	**PO6**	Recognize the need for independent, life-long learning and engage in the broadest context of technological change.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Programme Educational Objectives and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	A	B	C	D	E	F
1	3	3	2	3	2	2
2	3	3	3	3	3	2
3	3	3	3	3	3	2

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

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

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES					
	A	B	C	D	E	F
1	3	3	2	3	2	2
2	3	3	3	3	3	2

Contribution **1: Reasonable** **2: Significant** **3: Strong**

NANDHA ENGINEERING COLLEGE (AUTONOMOUS), ERODE – 638 052

REGULATIONS – 2022 CHOICE BASED CREDIT SYSTEM

M.E. COMPUTER SCIENCE AND ENGINEERING

SEMESTER: I									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22CPA01	Theoretical Foundations of Computer Science	FC	-	3	3	0	0	3
2	22CPB01	Networking Technologies	PCC	-	3	3	0	0	3
3	22CPB02	Advanced Data Structures and Algorithms	PCC	-	3	3	0	0	3
4	22CPB03	Advanced Database Technology	PCC	-	3	3	0	0	3
5	22CPB04	Multi core Architecture and Programming	PCC	-	3	3	0	0	3
6	22CPB05	Machine Learning Techniques	PCC	-	3	3	0	0	3
PRACTICAL									
7	22CPP01	Advanced Data Structures Laboratory	PCC	-	4	0	0	4	2
Audit Non Credit Courses									
8	A1	Audit Course	EEC	Ref. AC	2	2	0	0	0
				TOTAL	**24**	**20**	**0**	**4**	**20**

SEMESTER: II									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22CPB06	Big Data Analytics	PCC	-	3	3	0	0	3
2	22CPB07	Security Principles and Practices	PCC	-	3	3	0	0	3
3	22CPB08	Internet of Things	PCC	-	3	3	0	0	3
4	E1	Elective (PEC/OEC)	PEC/OEC	Ref. PE	3	3	0	0	3
5	E2	Elective (PEC)	PEC	Ref. PE	3	3	0	0	3
6	E3	Elective (PEC)	PEC	Ref. PE	3	3	0	0	3
PRACTICAL									
7	22CPP02	Big Data Analytics Laboratory	PCC	-	4	0	0	4	2
8	22CPE01	Technical Term Paper	EEC	-	4	0	0	4	2
				TOTAL	**26**	18	0	8	22

SEMESTER: III									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	E4	Elective (PEC)	PEC	Ref. PE	3	3	0	0	3
2	E5	Elective (PEC)	PEC	Ref. PE	3	3	0	0	3
3	E6	Elective (PEC)	PEC	Ref. PE	3	3	0	0	3
PRACTICAL									
4	22CPE02	Project Phase I	EEC	-	12	0	0	12	6
				TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER: IV									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
PRACTICAL									
1	22CPE03	Project Phase II	EEC	22CPE02	24	0	0	24	12
				TOTAL	**24**	**0**	**0**	**24**	**12**

(A) FC,PCC, PEC, OEC, EEC and AC Courses

(a) FOUNDATION COURSES(FC)

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CPA01	Theoretical Foundations of Computer Science	FC	NIL	3	3	0	0	3

(b) PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CPB01	Networking Technologies	PCC	NIL	3	3	0	0	3
2	22CPB02	Advanced Data Structures and Algorithms	PCC	NIL	3	3	0	0	3
3	22CPB03	Advanced Database Technology	PCC	NIL	3	3	0	0	3
4	22CPB04	Multi core Architecture and Programming	PCC	NIL	3	3	0	0	3
5	22CPB05	Machine Learning Techniques	PCC	NIL	3	3	0	0	3
6	22CPP01	Advanced Data Structures Laboratory	PCC	NIL	4	0	0	4	2
7	22CPB06	Big Data Analytics	PCC	NIL	3	3	0	0	3
8	22CPB07	Security Principles and Practices	PCC	NIL	3	3	0	0	3
9	22CPB08	Internet of Things	PCC	NIL	3	3	0	0	3
10	22CPP02	Big Data Analytics Laboratory	PCC	NIL	4	0	0	4	2

(c) PROFESSIONAL ELECTIVE COURSES (PEC)

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22CPX01	Cloud Computing	PEC	NIL	3	3	0	0	3
2	22CPX02	Data Warehousing and Data Mining	PEC	NIL	3	3	0	0	3
3	22CPX03	Software Requirement Engineering	PEC	NIL	3	3	0	0	3
4	22CPX04	Agile Software Development Methodologies	PEC	NIL	3	3	0	0	3
5	22CPX05	Advanced Operating Systems	PEC	NIL	3	3	0	0	3
6	22CPX06	Semantic Web	PEC	NIL	3	3	0	0	3
7	22CPX07	Deep Learning	PEC	NIL	3	3	0	0	3
8	22CPX08	Digital Image Processing and Applications	PEC	NIL	3	3	0	0	3
9	22CPX09	Information Retrieval Techniques	PEC	NIL	3	3	0	0	3
10	22CPX10	Web Services	PEC	NIL	3	3	0	0	3
11	22CPX11	Mobile Application Development	PEC	22CPB01	3	3	0	0	3
12	22CPX12	Wireless Sensor Networks	PEC	22CPB01	3	3	0	0	3
13	22CPX13	Natural Language Processing	PEC	NIL	3	3	0	0	3
14	22CPX14	GPU Computing	PEC	NIL	3	3	0	0	3
15	22CPX15	Compiler Construction and Optimization	PEC	NIL	3	3	0	0	3
16	22CPX16	Blockchain Technologies	PEC	NIL	3	3	0	0	3
17	22CPX17	Pattern Recognition	PEC	NIL	3	3	0	0	3
18	22CPX18	Virtualization Techniques	PEC	NIL	3	3	0	0	3
19	22CPX19	Quantum Computing	PEC	NIL	3	3	0	0	3

(d) OPEN ELECTIVE COURSES (OEC)									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1	22BAZ01	Research Methodology and IPR	OEC	NIL	3	3	0	0	3
2	22CPZ01	Machine Vision	OEC	NIL	3	3	0	0	3

(e) EMPLOYABILITY ENHANCEMENT COURSES (ECC)									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1	Ref. AC	Audit Course	EEC	NIL	2	2	0	0	0
2	22CPE01	Technical Term Paper	EEC	NIL	4	0	0	4	2
3	22CPE02	Project Phase I	EEC	NIL	12	0	0	12	6
4	22CPE03	Project Phase II	EEC	22CPE02	24	0	0	24	12

(f) AUDIT COURSES (AC)									
S. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1.	22PGA01	English for Research Paper Writing	EEC	NIL	2	2	0	0	0
2.	22PGA02	Disaster Management	EEC	NIL	2	2	0	0	0
3.	22PGA03	Constitution of India	EEC	NIL	2	2	0	0	0

SUMMARY						
S.No.	SUBJECT AREA	CREDITS AS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
I	FC	3	0	0	0	**3**
2	PCC	17	11	0	0	**28**
3	PEC	0	9	9	0	**18**
4	EEC	0	2	6	12	**20**
TOTAL CREDITS		**20**	**22**	**15**	**12**	**69**

TOTAL CREDITS (20+22+15+12) = 69 CREDITS

22CPA01 - THEORETICAL FOUNDATIONS OF COMPUTER SCIENCE					
			L	**T**	**P**	**C**
			3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn about cardinality, finite and countable infinite sets and to determine their characteristics	**1.1**	The Students will be able to arrive at conclusions about sets and relations, construct the number of arrangements and selections using principles of counting.		
2.0	To impart the knowledge of propositional and predicate logics.	**2.1**	The Students will be able to solve propositional logic, including modeling English description with propositions and connectives along with truth analysis and will be conversant in predicate logic.		
3.0	To explain about various types of graphs including Regular graphs and Random graphs.	**3.1**	The Students will be able to identify spanning trees, cut sets, isomorphism and different representation of a graph.		
4.0	To inculcate more complex queuing systems.	**4.1**	The Students will be able to analyze the basic characteristic features of a queuing system and models.		
5.0	To gain knowledge on advanced courses in automation theory, formal languages, algorithms & logic.	**5.1**	The Students will be able to solve problems using formal languages and automata.		

UNIT I - FOUNDATIONS	**(9)**
Sets-Relations-Equivalence relations-Partial orders-Functions-Recursive functions-Sequences-Induction principle- Structural induction-Recursive algorithms-Counting - Pigeonhole principle-Permutations and Combinations (Self study)-Recurrence relations.	
UNIT II - LOGIC	**(9)**
Propositional logic-Logical connectives-Truth tables-Normal forms (conjunctive and disjunctive)-Predicate logic- Universal and existential quantifiers-Proof techniques-Direct and Indirect-Proof by contradiction-Mathematical Induction (Self study).	
UNIT III - GRAPH STRUCTURES	**(9)**
Tree Structures- Graph Structures- Graph Representations-Regular graph structures-Random graphs-Connectivity- Cycles-Graph coloring-Cliques, Vertex Covers, Independent sets-Spanning Trees-Network flows(Self study)- Matching.	
UNIT IV - QUEUE MODELS	**(9)**
Characteristics of Queuing Models- Kendal's Notation-Single and Multi-Server Markovian queuing models – M/M/1, M/M/C(Self study) (finite and infinite capacity) and (M/G/1) :(∞/GD).	

UNIT V - MODELING COMPUTATION AND LANGUAGES	(9)
Finite state machines – Deterministic and Non- deterministic finite state machines – Turing Machines – Formal Languages – Classes of Grammars – Type 0 – Context Sensitive – Context Free – Regular Grammars(Self study) – Ambiguity.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th edition, TMH, 2011.
2. M.K. Venkataraman, N. Sridharan and N.Chandrasekaran," Discrete Maths.", The National Publishing Company, 2003.
3. Kishore S Trivedi, "Probability and statistics with reliability, Queuing and computer science applications", PHI, 2006.
4. H. A.Taha, ," Operations Research" - An Introduction,9th Edition, Prentice Hall of India Ltd New Delhi, 2014.
5. Ralph P Girmaldi and B.V. Ramana ,"Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education ,Asia, Delhi, 5th Edition, 2006.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	-	1	-	-	2	2	-
2	3	-	1	2	-	2	2	-
3	3	-	1	-	-	2	-	2
4	2	-	-	1	1	2	-	-
5	3	-	1	2	-	2	2	2
CO (W.A)	3	-	1	2	1	2	2	2

22CPB01 - NETWORKING TECHNOLOGIES					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn about integrated and differentiated services architectures.	**1.1**	The student will able to identify the different features of integrated and differentiated services.		
2.0	To know about TCP performance & congestion avoidance techniques.	**2.1**	The students will be able to outline an insight of TCP performance, congestion avoidance and control.		
3.0	To study the developments in cellular networks and understand the working of wireless network protocols.	**3.1**	The student will able to design and demonstrate protocols for cellular & wireless networks.		
4.0	To get familiarized with next generation networks.	**4.1**	The student will able to analyze the use of next generation networks.		
5.0	To know the concepts behind software defined networks.	**5.1**	The student will be able to provide solutions using SDN.		

UNIT I - NETWORK ARCHITECTURE AND QoS	**(9)**
Overview of TCP/IP Network Architecture – Integrated Services Architecture – Approach – Components – Services – Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services.	
UNIT II - TCP PERFORMANCE MODELING	**(9)**
TCP Segment format - TCP Sliding Windows - Congestion Control and Queuing – TCP Congestion Control - Analysis of TCP: Buffer Sizing - Throughput - Fairness - Random Early Detection Gateways for Congestion Avoidance. - Congestion Control for High Bandwidth - Delay Product Networks - Variations of TCP.	
UNIT III - CELLULAR AND WIRELESS NETWORKS	**(9)**
GSM – GPRS – UMTS – UTRAN - UMTS Security - IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – WLAN: Configuration and Security– IEEE 802.11e and WMM – Comparison of WLAN and UMTS – Bluetooth.	
UNIT IV - 4G NETWORKS	**(9)**
LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) – 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G& XG networks.	

UNIT V - SOFTWARE DEFINED NETWORKS	(9)
Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. William Stallings, "High Speed Networks and Internets: Performance and Quality of Service", Prentice Hall, 2nd Edition, 2002.
2. James F Kurose, Keith W Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Pearson Education, India, 2012.
3. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.
4. Martin Sauter,"3G, 4G And Beyond–Bringing Networks, Devices And The Web Together" A John Wiley & Sons, Ltd., Publication, 2nd Edition, 2013.
5. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
6. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2014.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	1	3	2	2	-	3	3	2
2	3	2	2	3	1	2	1	2
3	3	3	-	3	2	1	2	1
4	3	2	1	2	2	2	3	3
5	-	3	3	2	3	3	3	3
CO (W.A)	2.5	2.6	2	2.4	2	2.2	2.4	2.2

22CPB02 - ADVANCED DATA STRUCTURES AND ALGORITHMS					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To extend the students' knowledge on basic techniques of algorithm analysis.	**1.1**	The student will be able to use recursive design.		
2.0	To get familiarized with various types of tree structures.	**2.1**	The student will be able to choose appropriate tree data structure as applicable to specified problem definition.		
3.0	To learn the usage of graphs and its applications	**3.1**	The student will be able to design algorithms using graph structure to solve real-life problems		
4.0	To impart knowledge on different algorithm design techniques.	**4.1**	The student will be able to use different algorithm Design Techniques.		
5.0	To learn about advanced algorithms.	**5.1**	The student will be able to apply suitable design strategy for problem solving		

UNIT I - ALGORITHM ANALYSIS	**(9)**
Asymptotic Notations – Properties of Big-oh Notation – Conditional Asymptotic Notation –Algorithm Analysis: Analysis of iterative and recursive Algorithms –Introduction to Linear and Non Linear data structures.	
UNIT II - HIERARCHICAL DATA STRUCTURES	**(9)**
Binary Search Trees – AVL Trees – Red-Black –Properties of Red-Black Trees –Insertion and Deletion-Min/Max heaps– Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps.	
UNIT III - GRAPHS	**(9)**
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components – Minimum Spanning Trees- Single –Source Shortest Paths –All Pairs Shortest Paths – Maximum Flow.	
UNIT IV - ADVANCED ALGORITHMS	**(9)**
Huffman Coding – Convex Hull – Closest pair of points – Tree Vertex Splitting – Activity Networks – Flow Shop Scheduling – Introduction to Randomized algorithms.	
UNIT V - NP COMPLETE AND NP HARD	**(9)**
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility - NP Complete Problems - Approximation Algorithms: Travelling Salesman Problem - Sum of Subset Problem - Vertex Cover Problem.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein," Introduction to Algorithms", 4th Edition, Prentice Hall of India, New Delhi, 2022.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Pearson Education, 2014.
3. E. Horowitz, S.Sahni and Dinesh Mehta, "Fundamentals of Data structures in C++", University Press, 2008.
4. E. Horowitz, S. Sahni and S. Rajasekaran, "Computer Algorithms/C++", 2nd Edition, University Press, 2007.
5. Alfred .V. Aho, John .E. Hopcroft, and Jeffrey .D. Ullman, "Data Structures and Algorithms", Addison-Wesley Publications, 2008.
6. Anany Levitin, "Introduction to the Design and Analysis of algorithms", 3rd Edition, Pearson, USA, 2012.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	3	3	3	3	3	1	1
2	2		2	3	3	3	2	2
3	3	-	3	3	3	3	3	3
4	3	-	3	2	1	3	3	3
5	3	3	3	3	3	3	3	3
CO (W.A)	2.8	3	2.8	2.8	2.6	3	2.4	2.4

22CPB03 - ADVANCED DATABASE TECHNOLOGY					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To acquire knowledge on parallel and distributed databases and its applications.	**1.1**	The students will be able to select the appropriate high performance database like parallel and distributed database.		
2.0	To study the usage and applications of Object Oriented database.	**2.1**	The students will be able to model and represent the real world data using object oriented database.		
3.0	To understand the usage of advanced data models.	**3.1**	The students will be able to design a semantic based database to meaningful data access.		
4.0	To gain knowledge about intelligent databases.	**4.1**	The students will be able to embed the rule set in the database to implement intelligent databases.		
5.0	To acquire inquisitive attitude towards research topics in database like NoSQL.	**5.1**	The students will be able to demonstrate competency in designing and selecting a particular NoSQL database for specific use cases.		

UNIT I - PARALLEL DATABASES	**(9)**
Database System Architectures: Centralized and Client-Server Architectures - Server System Architectures - Parallel Systems- Parallel Databases: 1/0 Parallelism - Inter and Intra Query Parallelism - Inter and Intra operation Parallelism- Design of Parallel Systems.	
UNIT II - DISTRIBUTED DATABASES	**(9)**
Distributed Database Concepts - Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control - Distributed Query Processing.	
UNIT III - OBJECT BASED DATABASES	**(9)**
Concepts for Object Databases: Object Identity - Object structure - Type Constructors - Encapsulation of Operations - Methods - Persistence - Type and Class Hierarchies - Inheritance - Complex Objects - Object Database Standards, Languages and Design: ODMGModel - ODL - OQL .	
UNIT IV - INTELLIGENT DATABASES	**(9)**
Active Databases: Syntax and Semantics -Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- Deductive Databases: Logic of Query Languages - Data log Recursive Rules-Syntax and Semantics of Data log Languages- Implementation of Rules and Recursion Recursive Queries in SQL- Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures Spatial Access Methods- Mobile Databases.	

UNIT V - NOSQL DATABASES	(9)
Introduction to Big Data-Storage- NoSQL Introduction - Differences from relational databases- Column family store- Document stores - key-value databases - Graph databases - Choosing a NoSQL database.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", 7 t h Edition, Pearson Education/Addison Wesley, 2017.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 6th Edition, Pearson Education, 2015.
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", 7th Edition, McGraw Hill, 2019.
4. C. J. Date, A.Kannan and S. Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	-	2	3	-	3	2
2	3	2	1	2	3	-	3	2
3	-	-	1	-	-	1	3	3
4	3	3	2	2	3	2	3	3
5	3	3	-	2	3	-	3	3
CO (W.A)	3	2.5	1.33	2	3	1.5	3	2.6

22CPB04 – MULTICORE ARCHITECTURE AND PROGRAMMING					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the basic structure and operation of Multicore architecture and parallel processing.	**1.1**	The student will be able to analyze the working principle of ILP.		
2.0	To understand parallel programming concepts and threading APIs.	**2.1**	The student will be able to know the concepts of threading and parallel programming constructs.		
3.0	To understand Memory Hierarchy Design and virtual machines.	**3.1**	The student will be able to understand the concept of Memory Hierarchy Design and virtual machines.		
4.0	To understand MPI programming and multicore debugging techniques.	**4.1**	The student will be able to understand the issues related to processors, memories, I/O devices.		
5.0	To provide knowledge of memory technologies, interfacing techniques and subsystem devices.	**5.1**	The student will be able to use memory technologies, interfacing techniques and subsystem devices efficiently.		

UNIT I - INTRODUCTION	**(9)**
Classes of Computers-Trends in Technology-Trends in Power and Energy in Integrated Circuits- Instruction Level Parallelism-Basic Compiler Techniques for Exposing ILP-Software and hardware multithreading – SMT and CMP architectures –Design issues – Case studies – Intel Multi-core architecture	
UNIT II – PARALLEL PROGRAMMING	**(9)**
Fundamental concepts – Designing for threads – Scheduling - Threading and parallel Programming constructs – Synchronization – Critical sections – Deadlock - Threading APIs	
UNIT III – MEMORY HIERARCHY DESIGN	**(9)**
Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies .	
UNIT IV – MPI PROGRAMMING	**(9)**
MPI Model – Collective communication – Data decomposition – Communicators and topologies – Interconnection networks – Buses, crossbar-Multi-stage switches – Point-to-point communication – MPI Library	
UNIT V – MULTI THREAD AND STORAGE APPLICATION	**(9)**
Algorithms, program development and performance tuning-Advanced topics in disk storage-Video control–I/O Performance–SMART technology and fault detection–Processor to network interfaces	
	TOTAL (L:45) : 45 PERIODS

REFERENCES :

1. John L. Hennessey and David A. Patterson, "Computer architecture – A quantitative approach", Morgan Kaufmann/Elsevier Publishers, 6th Edition, 2019.
2. Shameem Akhter and Jason Roberts, "Multi-core Programming", Intel Press, 2010.
3. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2004.
4. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A hardware/ Software Approach", Morgan Kaufmann/Elsevier Publishers, 1999.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	-	-	-	3	-	2	3	3
2	2	-	-	-	3	2	3	3
3	-	-	1	3	3	2	2	2
4	-	-	2	2	2	2	1	1
5	-	-	1	2	2	2	1	-
CO (W.A)	2	-	1.33	2.5	2.5	2	2	2.75

22CPB05 - MACHINE LEARNING TECHNIQUES					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the concepts of Machine Learning.	**1.1**	The students will be able to learn the types of machine learning models.		
2.0	To appreciate supervised learning and their applications.	**2.1**	The students will be able to use the supervised learning algorithms for any given problem.		
3.0	To appreciate the concepts and algorithms of unsupervised learning.	**3.1**	The students will be able to use the unsupervised learning algorithms for any given problem.		
4.0	To understand the theoretical and practical aspects of Probabilistic Graphical Models.	**4.1**	The students will be able to apply the graphical models of machine learning		
5.0	To appreciate the concepts and algorithms of advanced learning.	**5.1**	The students will be able to identify applications suitable for different types of Machine Learning with suitable justification.		

UNIT I - INTRODUCTION	**(9)**
Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.	
UNIT II - SUPERVISED LEARNING	**(9)**
Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi-layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines.	
UNIT III - UNSUPERVISED LEARNING	**(9)**
Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis	
UNIT IV - PROBABILISTIC GRAPHICAL MODELS	**(9)**
Graphical Models – Undirected Graphical Models – Directed Graphical Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields- Hidden Markov Models – Conditional Random Fields(CRFs).	
UNIT V - ADVANCED LEARNING	**(9)**
Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.	
	TOTAL (L:45) : 45 PERIODS

REFERENCES :

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Chapman and Hall, CRC Press, 2nd Edition, 2014.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 3rd Edition, 2014.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 3rd Edition,2013.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	1	-	2	3	3	2
2	3	1	2	1	2	3	2	2
3	3	2	3	2	3	3	2	3
4	3	1	2	3	2	3	3	2
5	3	3	3	3	3	3	3	3
CO (W.A)	3	1.6	2.2	2.3	2.4	3	2.6	2.4

22CPP01 - ADVANCED DATA STRUCTURES LABORATORY

	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To gain knowledge on various basic and advanced data structures.	**1.1**	Student will be able to formulate new solutions for programming problems
2.0	To know various techniques for representation of the data in the real world.	**2.1**	The students will be able to identify the appropriate data structure for given problem.
3.0	To have practical knowledge on data structure applications.	**3.1**	The students will be able to develop the application of data structures.
4.0	To learn about implementation of various tree data structures.	**4.1**	Student will be able to handle operations like searching, insertion, deletion mechanism on tree data structures.
5.0	To have practical knowledge on advanced data structure concepts.	**5.1**	Student will be able to determine and demonstrate advanced data structures.

LIST OF EXPERIMENTS:

1. Implementation of the following Heap data structures
   - i) Min/Max Heap(Insertion, Delete Min, Delete Max)
   - ii) Skew Heap and Fibonacci Heap
2. Implementation of the following Search Structures
   - i) AVL Trees (Insertion, Deletion and Search)
   - ii) Splay Trees (Insertion, Deletion and Search)
   - iii) B-Trees (Insertion, Deletion and Search)
   - iv) Red-Black Trees.
3. Implementation of Topological sort.
4. Implementation of Convex Hull.
5. Solve NP Problems- sum of Subset problem.

TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	-	3	3	1	3	3	3
2	3	-	3	3	-	2	3	3
3	3	-	3	3	-	2	3	3
4	3	-	3	3	-	2	3	3
5	3	-	3	3	-	2	3	3
CO (W.A)	3	-	3	3	1	2	3	3

22CPB06 - BIG DATA ANALYTICS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To provide an overview of an exciting growing field of big data analytics.	**1.1**	The student will able to understand the fundamentals of various big data analytics techniques.		
2.0	To introduce the tools required to manage and analyze big data like Hadoop, NoSql.	**2.1**	The student will able to acquire fundamental enabling techniques and scalable algorithms like Hadoop, NO SQL in big data analytics		
3.0	To teach the fundamental techniques and programming in achieving big data analytics with scalability and streaming capability.	**3.1**	The student will able to Categorize and summarize the fundamental techniques and programming in Big Data and its importance.		
4.0	To introduce programming tools PIG & HIVE in Hadoop echo system	**4.1**	The student will able to explore on Big Data applications Using Pig and Hive.		
5.0	To enable students to learn to use various techniques for mining data stream.	**5.1**	The student will be able to build a complete business data analytics solution		

UNIT I - INTRODUCTION TO BIG DATA AND ANALYTICS	**(9)**
Introduction to Big Data - Classification of Digital Data, Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Big Data Analytics importance - Data Science- Terminologies used in Big Data Environments - Analytics Tools.	
UNIT II - INTRODUCTION TO TECHNOLOGY LANDSCAPE	**(9)**
NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop – Distributed Computing Challenges – Hadoop Overview - Hadoop Distributed File System – Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem.	
UNIT III - INTRODUCTION TO MONGODB ,CASSANDRA AND MAPREDUCE PROGRAMMING	**(9)**
MongoDB: Terms used in Mongo DB - Data Types - MongoDB Query Language- Cassandra: Features - CQL Data Types –CRUD Operations – Collections alter Commands - Import and Export - Querying System Tables. MapReduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.	
UNIT IV - INTRODUCTION TO HIVE AND PIG	**(9)**
Hive: Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub- Query – Joins – Aggregations - Group by and Having - RCFile Implementation - Hive User Defined Function - Serialization and Deserialization. Pig: Introduction - Anatomy – Features – Philosophy - Use Case for Pig – Pig Latin Overview - Pig Primitive Data Types - Running Pig - Execution Modes of Pig – HDFS Commands - Relational Operators - Eval Function - Complex Data Types - Piggy Bank - User-Defined Functions - Parameter Substitution - Diagnostic Operator - Word Count Example using Pig - Pig at Yahoo	

UNIT V - INTRODUCTION TO DATA ANALYTICS WITH R	(9)
Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Machine Learning Algorithms: Regression Model, Clustering, Collaborative Filtering, Associate Rule Making, Decision Tree, Big Data Analytics with BigR.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Seema Acharya, SubhashiniChellappan, "Big Data and Analytics", Wiley Publications, 2nd Edition,2019
2. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big data for dummies", John Wiley & Sons, Inc.,2013.
3. Tom White, "Hadoop The Definitive Guide", O'Reilly Publications, 4th Edition,2015
4. Dirk Deroos, Paul C.Zikopoulos, Roman B.Melnky, Bruce Brown, Rafael Coss, "Hadoop For Dummies", Wiley Publications,2014
5. Robert D.Schneider, "Hadoop For Dummies", John Wiley & Sons, Inc.,2012
6. Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill, 2012
7. Chuck Lam, "Hadoop In Action", Dreamtech Publications, 2010

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	1	-	2	3	2	2
2	3	2	2	1	2	3	2	2
3	3	2	3	2	3	3	2	3
4	3	2	2	3	2	3	2	2
5	3	3	3	3	3	3	3	3
CO (W.A)	3	2	2.2	1.8	2.4	3	2.2	2.4

22CPB07 - SECURITY PRINCIPLES AND PRACTICES					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn the core fundamentals of system security concepts.	**1.1**	The students will be able to comprehend the core fundamentals of system security.		
2.0	To have thorough knowledge in the security concepts related to networks.	**2.1**	The students will be able to apply the security concepts related to networks in wired and wireless scenario.		
3.0	To deploy the security essentials in IT Sector.	**3.1**	The students will be able to implement and manage the security essentials in IT Sector.		
4.0	To be exposed to the concepts of Cyber Security and encryption Concepts.	**4.1**	The students will be able to elucidate the notion of cyber security and encryption concepts.		
5.0	To perform a detailed study of Privacy and Storage security and related Issues.	**5.1**	The students will be able to procure intelligence in the area of privacy and storage security and related issues.		

UNIT I - SYSTEM SECURITY	**(9)**
Building a secure organization- A Cryptography primer- detecting system Intrusion, Preventing system Intrusion - Guarding Against Network Intrusions: Preventive Measures - Intrusion Monitoring and Detection - Reactive Measures.	
UNIT II - NETWORK SECURITY	**(9)**
Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Cellular Network Security – RFID Security.	
UNIT III - SECURITY MANEGEMENT	**(9)**
Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Identity Management - Intrusion and Detection and Prevention System.	
UNIT IV - CYBER SECURITY AND CRYPTOGRAPHY	**(9)**
Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption- Satellite Encryption –Public key Infrastructure.	
UNIT V - PRIVACY AND STORAGE SECURITY	**(9)**
Privacy in the Digital Society - Privacy Enhancing Technologies - Personal privacy Policies –VoIP Security - Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. John R.Vacca, "Computer and Information Security Handbook", 3rd Edition, Elsevier 2017.
2. Herbert J. Mattord and Michael E. Whitman, "Principal of Information Security", 6th Edition, Cengage Learning,2017
3. Richard E.Smith, "Elementary Information Security", 3rd Edition, Jones and Bartlett Learning, 2019.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	-	3	3	2	2	3	3
2	3	-	3	3	3	3	3	3
3	3	-	3	3	2	3	3	3
4	3	-	3	3	2	3	3	3
5	3	-	3	3	3	3	3	3
CO (W.A)	3	-	3	3	2.4	2.8	3	3

22CPB08 - INTERNET OF THINGS					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : Basic programming skills, Basic electronics skills					
Course Objectives		**Course Outcomes**			
1.0	To learn the basic issues, policy and challenges in the Internet	**1.1**	The students will be able to identify the components of IOT		
2.0	To understand the components and the protocols in Internet	**2.1**	The students will be able to design a portable IOT using appropriate boards		
3.0	To build a small low cost embedded system with the internet	**3.1**	The students will be able to program the sensors and controller as part of IOT		
4.0	To understand the various modes of communications with internet	**4.1**	The students will be able to develop schemes for the applications of IOT in real time scenarios		
5.0	To learn to manage the resources in the Internet	**5.1**	The students will be able to establish the communication to the cloud through Wi-Fi / Bluetooth		

UNIT I - INTRODUCTION	**(9)**
Definition – phases – Foundations – Policy– Challenges and Issues - identification - security – privacy. Components in internet of things: Control Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – RF links – Mobile Internet – Wired Communication.	
UNIT II – PROGRAMMING THE MICROCONTROLLER FOR IOT	**(9)**
Basics of Sensors and actuators – Examples and working principles of sensors and actuators – Cloud computing and IOT – Arduino/Equivalent Microcontroller platform – Setting up the board - Programming for IOT – Reading from Sensors - Communication-Connecting microcontroller with mobile devices – communication through Bluetooth and USB – connection with the internet using WiFi / Ethernet	
UNIT III - RESOURCE MANAGEMENT IN THE INTERNET OF THINGS	**(9)**
Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object - Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behavior of Objects.	

UNIT IV - BUSINESS MODELS FOR THE INTERNET OF THINGS	(9)
The Meaning of DiY in the Network Society- Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework - Device Integration - Middleware Technologies Needed for a DiY Internet of Things – Semantic Interoperability as a Requirement for DiY Creation - Ontology- Value Creation in the Internet of Things- Application of Ontology Engineering in the Internet of Things-Semantic Web-Ontology – The Internet of Things in Context of EURIDICE - Business Impact.	
UNIT V - FROM THE INTERNET OF THINGS TO THE WEB OF THINGS	**(9)**
Resource-oriented Architecture and Best Practices- Designing RESTful Smart Things - Web-enabling Constrained Devices - The Future Web of Things - Set up cloud environment – send data from microcontroller to cloud – Case study –CAM:cloud Assisted Privacy– Other recent projects.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Charalampos Doukas , "Building Internet of Things with the Arduino", Create space, April 2012.
2. Dieter Uckelmann et.al, "Architecting the Internet of Things", Springer, 2011
3. Luigi Atzor et.al, "The Internet of Things: A survey", Journal on Networks, Elsevier Publications, October, 2010
4. Huang Lin, Gainesville, Jun Shao, Chi Zhang, Yuguang Fang, "CAM: Cloud-Assisted Privacy Preserving Mobile Health Monitoring", IEEE Transactions on Information Forensics and Security, 2013
5. Pengwei Hu; Fangxia Hu, "An optimized strategy for cloud computing architecture", 3rd IEEE Transactions on Computer Science and Information Technology (ICCSIT), 2010.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	2	2	3	-	3	2
2	3	2	-	2	3	-	3	2
3	-	-	1	-	-	1	3	3
4	3	3	3	2	3	2	3	3
5	3	3	-	2	3	-	3	3
CO (W.A)	3	2.5	2.33	2	3	1.5	3	2.6

22CPP02 - BIG DATA ANALYTICS LABORATORY					
		L	T	P	C
		0	0	4	2

PREREQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the installation and configuration procedure for Hadoop and HDFC	**1.1**	The student will able to improve the Knowledge of Hadoop and HDFC file system tools
2.0	To understand and implement Map Reduce programs and R for processing big data.	**2.1**	The student will able to identify problems, analyze, and evaluate using various R, MapReduce Programs.
3.0	To understand and how to run the Hive tools.	**3.1**	The student will able to know various tools in Hive.
4.0	To learn about various queries in Pig.	**4.1**	The student will able to exhibit new ideas and innovations in Hive and Pig.
5.0	To gain knowledge on analyzing big data using linear models, machine learning techniques such as SVM / Decision tree classification and clustering.	**5.1**	The student will able to build and apply linear and logistic regression models and perform data analysis with machine learning method.

LIST OF EXPERIMENTS:

HADOOP,HIVE AND PIG

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce,Hive.
3. Implement an MR program that processes a weather dataset
4. Design and Implement the following Mapreduce programs
   a) Writing mapper programs b) Writing reducer programs
5. Develop and execute the Partitions and Buckets partitioning program in Hive.
6. Design and Implement the following Hive Tables
   a) Importing Data. b)Querying Data
7. Pig Queries [Hands-on]

R

8.Implement Linear and logistic Regression

9.Implement SVM / Decision tree classification techniques

10.Implement clustering techniques

11.Visualize data using any plotting framework

12. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3		3	3	1	3	3	3
2	3	1	3	3	1	2	3	3
3	3	1	3	3	1	2	3	3
4	3	1	3	3	1	2	3	3
5	3	1	3	3	1	2	3	3
CO (W.A)	3	1	3	3	1	2.2	3	3

22CPE01 - TECHNICAL TERM PAPER				
	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To provide exposure to the students to refer, read and review the research articles in referred journals and conference proceedings.	1.1	At the end of the course the student will be able to read and review the research articles and publish a technical paper.

METHODOLOGY

- Each student is allotted to a faculty of the department by the Dean/ HOD.
- By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student.
- The students have to refer the Journals and Conference proceedings and collect the published literature.
- The student is expected to collect at least 20 such Research Papers published in the last 5 years.
- Using OHP/PowerPoint, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion.
- The student has to make two presentations, one at the middle and the other near the end of the semester.
- The student has to write a Technical Report for about 30-50 pages (Title page, one page Abstract, Review of Research paper under various sub headings, Concluding Remarks and List of References).The technical report has to be submitted to the Dean/ HOD one week before the final presentation, after the approval of the faculty guide.

EXECUTION

Week	Activity
I	Allotment of Faculty Guide by the Dean/ HoD
II	Finalizing the topic with the approval of Faculty Guide
III-IV	Collection of Technical papers
V-VI	Mid semester presentation
VII-VIII	Report writing
IX	Report submission
X-XI	Final presentation

EVALUATION

100%by Continuous Assessment - 3 Hrs/week and 1 credit	
Component	Weight age
Mid semester presentation	25%
Final presentation(Internal)	25%
End Semester Examination Report	30%
Presentation	20%
Total	100%

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	3	3	3	3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3

22CPE02 - PROJECT PHASE I				
	L	T	P	C
	0	0	12	6

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature, the methodology to solve the identified problem and preparing project reports and to face reviews and viva-voce examination.	1.1	At the end of the course the students will have a clear idea of their area of work and they will be in a position to carry out the phase II project work in a systematic way.

SYLLABUS:

- Student individually works on a specific topic approved by the head of the department under the guidance of a faculty member who is familiar in this area.
- The student can select any topic which is relevant to the area of Computer Science and Engineering. The topic may be theoretical or case studies.
- At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work.
- The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL (P:180) : 180 PERIODS

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	3	3	3	3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3

22CPE03 - PROJECT PHASE II				
	L	T	P	C
	0	0	24	12

PRE REQUISITE : 22CPE02

Course Objectives		Course Outcomes	
1.0	To solve the identified problem based on the formulated methodology.	1.1	On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering design and find better solutions to it.

SYLLABUS:

- Student should continue the phase - I work on the selected topic as per the formulated methodology. At the end of the semester,
- After completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department.
- The students will be evaluated based on the report submitted and the viva -voce examination by a panel of examiners including one external examiner.

TOTAL (P:360) : 360 PERIODS

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	3	3	3	3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3

22CPX01 - CLOUD COMPUTING					
		L	T	P	C
		3	0	0	3

PREREQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the concepts of virtualization and virtual machines	**1.1**	The students will be able to employ the concepts of storage virtualization, network virtualization and its management
2.0	To gain knowledge on the concept of virtualization that is fundamental to cloud computing	**2.1**	The students will be able to apply the concept of virtualization in the cloud computing
3.0	To understand the various issues in cloud computing	**3.1**	The students will be able to identify the architecture, infrastructure and delivery models of cloud computing
4.0	To be able to set up a private cloud	**4.1**	The students will be able to develop services using Cloud computing
5.0	To understand the security issues in the grid and the cloud environment	**5.1**	The students will be able to apply the security models in the cloud environment

UNIT – I ELEMENTARY CONCEPTS	**(9)**
Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization	
UNIT – II INFRASTRUCTURE	**(9)**
Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.	
UNIT – III CLOUD DEPLOYMENT MODELS & ARCHITECTURE	**(9)**
Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management	
UNIT – IV PROGRAMMING MODEL	**(9)**
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus	
UNIT – V SECURITY IN CLOUD	**(9)**
Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management.	
TOTAL (L: 45) = 45 PERIODS	

REFERENCES:

1. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner"s Guidell", McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2017.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2013.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	1	3	3	2	2	3	3
2	3	2	3	3	3	3	3	3
3	3	-	3	3	2	3	3	3
4	3	2	3	3	2	3	3	3
5	3	1	3	3	3	3	3	3
CO (W.A)	3	1.5	3	3	2.4	2.8	3	3

22CPX02 - DATA WAREHOUSING AND DATA MINING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the basic principles, concepts and applications of data mining	**1.1**	The students will be able to describe the concepts of data mining and perform statistical analysis of data.		
2.0	To enlighten the Data warehousing concepts and preprocessing techniques.	**2.1**	The students will be able to develop and apply preprocessing techniques and design data warehouse.		
3.0	To understand and create association rules	**3.1**	The students will be able to apply association rule mining methods to solve the given problem.		
4.0	To learn the importance of supervised learning and relevant algorithms,	**4.1**	The students will be able to apply classification techniques to solve real world problems.		
5.0	To learn the importance of unsupervised learning algorithms and recent trends.	**5.1**	The students will be able to utilize different clustering methods for various applications.		

UNIT I - INTRODUCTION TO DATA MINING	**(9)**
Data Mining – Steps in Knowledge Discovery Process – Kinds of Data and Patterns –Technologies used – Targeted applications – Major issues in Data Mining – Data objects and Attribute types – Statistical descriptions of data – Measuring data similarity and dissimilarity.	
UNIT II – DATA PREPROCESSING AND DATA WAREHOUSING	**(9)**
Data Preprocessing: Data Cleaning – Data Integration – Data Reduction – Data Transformation and Discretization – Data Warehouse Architecture –Data Warehouse: Concepts – Modeling – Design – Implementation – Need of Data Warehousing	
UNIT III - FREQUENT PATTERN MINING	**(9)**
Basic concepts – Frequent item set mining methods: Apriori Algorithm – A pattern growth approach for Mining frequent item sets – Pattern Evaluation methods – Multilevel – Multi dimensional frequent pattern mining.	
UNIT IV - CLASSIFICATION AND PREDICTION	**(9)**
Basic Concepts – Decision Tree Induction – Bayesian Classification – Classification by Back Propagation – Support Vector Machines – Model Evaluation and Selection – Techniques to Improve Classification Accuracy – Advanced methods.	
UNIT V - CLUSTER ANALYSIS AND TRENDS IN DATA MINING	**(9)**
Basic Concepts – Partitioning Methods – Hierarchical Methods – Density based Methods – Grid based Methods – Data Mining Applications – Data mining Trends: Mining complex Data types.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Han Jiawei, and Kamber Micheline, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2012.
2. Alex Berson and Stephen J.Smith,"Data Warehousing , Data Mining and OLAP" , Tata McGraw-Hill Edition,13th Reprint 2008.
3. Deepali Kamthania, "Data Warehousing and Data Mining" 1st Edition, IK International Publishing House Pvt Ltd., 2022.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	-	-	2	3	1	2
2	3	2	2	2	3	3	3	3
3	3	2	2	2	3	3	3	3
4	3	3	-	1	3	3	2	2
5	3	3	3	3	3	3	3	3
CO (W.A)	3	2.2	1.4	1.6	2.8	3	2.4	2.6

22CPX03 - SOFTWARE REQUIREMENT ENGINEERING					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the basic concepts of software requirements engineering.	**1.1**	The students will be able to define a process for requirement engineering.		
2.0	To be able to recognize requirements of each type, a prerequisite for effective documentation writing.	**2.1**	The students will be able to understand the professional and ethical responsibilities of a software engineer.		
3.0	To gain knowledge on the quality assurance and evolution	**3.1**	The students will be able to check the quality assurance for the project		
4.0	Develop the skills for building system models	**4.1**	The students will be able to draw UML diagrams and system models for a respective project.		
5.0	To understand the stakeholders involved in requirements engineering.	**5.1**	The students will be able to design a software within realistic constraints.		

UNIT I - INTRODUCTION	**(9)**
Introduction – Requirements engineering – categories of requirements –requirements in software life cycle-agile development process and requirement engineering- identifying stake holders-arte-fact driven elicitation techniques- stake holder driven elicitation technique-risk analysis-requirement prioritization.	
UNIT II – REQUIREMENT SPECIFICATION AND DOCUMENTATION	**(9)**
Diagrammatic notations: system scope-conceptual structures-activities and data-instruction flow-interaction scenarios-system behavior-stimuli and behavior-formal specification.	
UNIT III - QUALITY ASSURANCE AND EVOLUTION	**(9)**
Requirements inspection and review-validation by specification animation-verification through formal checks-evolution: time space dimension-change anticipation-traceability management- control management-runtime monitoring.	
UNIT IV - BUILDING SYSTEM MODELS	**(9)**
Modeling system objectives with goal diagrams-building goal models-risk analysis on goal models-modeling conceptual objects with class diagrams.	
UNIT V - REASONING ABOUT SYSTEM MODELS	**(9)**
Semiformal reasoning-formal specification of system models-formal reasoning for specification construction and analysis.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Axel van Lamsweerde, "Requirements Engineering", Wiley, 2009.
2. Dean Leffingwell and Don Widrig, "Managing Software Requirements: A Use Case Approach", 2nd Edition, Addison- Wesley, 2003.
3. Gerald Kotonya, Ian Sommerville, "Requirements Engineering: Processes and Techniques", John Wiley and Sons, 1998.
4. SEI Report, "Quality Attributes Workshop", http://www.sei.cmu.edu/library/abstracts/reports/03tr016.cfm, 2003.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	1	-	-	2	3	1	2
2	3	2	2	2	3	3	3	3
3	3	2	2	2	3	3	3	3
4	3	3	-	1	3	3	2	2
5	3	3	3	3	3	3	3	3
CO (W.A)	3	2.2	1.4	1.6	2.8	3	2.4	2.6

22CPX04 – AGILE SOFTWARE DEVELOPMENT METHODOLOGIES					
			L	**T**	**P**	**C**
			3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn the fundamental principles and practices associated with each of the agile development methods.	**1.1**	Analyze existing problems with the team, development process and wider organization		
2.0	To apply the principles and practices of agile software development on a project of interest and relevance to the student.	**2.1**	Apply a thorough understanding of Agile principles and specific practices.		
3.0	To provide a good understanding of software design and a set of software technologies and APIs.	**3.1**	Select the most appropriate way to improve results for a specific circumstance or need.		
4.0	To do a detailed examination and demonstration of Agile development and testing techniques.	**4.1**	Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems.		
5.0	To understand Agile development and testing.	**5.1**	Evaluate likely successes and formulate plans to manage likely risks or problems.		

UNIT I - AGILE SOFTWARE DEVELOPMENT	**(9)**
Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges. Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality.	
UNIT II – AGILE AND SCRUM PRINCIPLES	**(9)**
Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values	
UNIT III – AGILE PRODUCT MANAGEMENT	**(9)**
Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue	
UNIT IV – AGILE REQUIREMENTS AND AGILE TESTING	**(9)**
User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development, User Acceptance Test	

UNIT V – AGILE REVIEW AND SCALING AGILE FOR LARGE PROJECTS	(9)
Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools. Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Robert C. Martin ,"Agile Software Development, Principles, Patterns, and Practices" Alan Apt Series 2011.
2. Mike Cohn,"Succeeding with Agile : Software Development Using Scrum", Pearson Education, 2013.
3. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.
4. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009.
5. Craig Larman, "Agile and Iterative Development: A Managers Guide", Addison-Wesley, 2004.
6. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	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	2
4	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3

22CPX05 ADVANCED OPERATING SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand how an operating system performs its duties is to garner insight into how a computer functions at its innermost levels.	**1.1**	The students will be able to understand the potential benefits of distributed operating systems.
2.0	To learn a multiprogramming system, distributed operating systems.	**2.1**	The students will be able to implement various distributed operating system concepts.
3.0	To learn the principles of managing the main memory, one of the most precious resources in mechanisms of synchronization and resource management,.	**3.1**	The students will be able to allocate various resources efficiently for all the distributed processes.
4.0	To gain knowledge about the fault recovery and fault tolerance mechanisms of operating system.	**4.1**	The students will be able to familiar with protection and security mechanisms of operating system.
5.0	To provide exposure on database operating system.	**5.1**	The students will be able to identify the requirements of database operating systems.

UNIT I - PROCESS SYNCHRONIZATION	**(9)**
Overview - Functions of an Operating System –Types of Advanced Operating System - Synchronization Mechanisms – Concept of a Process, Concurrent Processes – The Critical Section Problem, Other Synchronization Problems – Language Mechanisms for Synchronization – Axiomatic Verification of Parallel Programs – Process Deadlocks - Preliminaries – Models of Deadlocks- Resources – A Graph-Theoretic model of System State – Necessary and Sufficient conditions for a Deadlock – Systems with Single-Unit Requests, Consumable Resources, Reusable Resources	
UNIT II - DISTRIBUTED OPERATING SYSTEMS	**(9)**
Issues – Communication Networks and Primitives – Theoretical Foundations - Inherent Limitations - Lamport‟s Logical Clock- Vector Clock- Causal Ordering of Messages- Global State- Distributed Mutual Exclusion – Classification- Preliminaries - Non-Token Based Algorithms – Lamport‟s Algorithm - Token-Based Algorithms – Suzuki-Kasami‟s Broadcast Algorithm– Distributed Deadlock Detection– Preliminaries – Handling of Deadlocks - Issues –Centralized Deadlock-Detection Algorithms - Distributed Deadlock Detection Algorithms – Hierarchical Deadlock Detection Algorithms.	
UNIT III – DISTRIBUTED RESOURCE MANAGEMENT	**(9)**
Distributed file system - Architecture–Design issues-Distributed Shared Memory- Algorithms for implementing DSM – Memory Coherence and Coherence Protocols – Design Issues- Distributed Scheduling – Issues in Load Distributing – Components of a Load Distributing Algorithm – Stability – Load Distributing Algorithm – Performance Comparison – Selecting a Suitable Load Sharing Algorithm – Requirements for Load Distributing - Task Migration and Issues.	

UNIT IV – FAILURE RECOVERY AND FAULT TOLERANCE	(9)
Recovery : Introduction – Basic Concepts – Classification of Failures – Backward and Forward Error Recovery Approaches - Recovery in Concurrent Systems – Synchronous and Asynchronous Check Pointing and Recovery – Check Pointing for Distributed Database Systems - Recovery in Replicated Distributed Databases Systems – Fault Tolerance – Issues- Commit Protocol- Non Blocking Commit Protocol-Voting Protocol - Dynamic Voting Protocol – Dynamic Vote Reassignment Protocol – Failure Resilient Processes – Reliable Communication.	
UNIT V – DATABASE OPERATING SYSTEMS	**(9)**
Introduction- Requirements of a Database Operating System- Concurrency Control: Theoretical Aspects – Database Systems – The Problem of Concurrency Control – Serializability. Theory- Distributed Database Systems- Concurrency Control Algorithms- Basic Synchronization Primitives – Lock Based Algorithms - Timestamp Based Algorithms - Optimistic Algorithms – Data Replication.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Mukesh Singhal and N. G. Shivaratri, "Advanced Concepts in Operating Systems", McGraw-Hill, 2011.
2. Abraham Silberschatz, Peter B. Galvin and G. Gagne, "Operating System Concepts", 9th Edition, Addison Wesley Publishing Co., 2013.
3. Andrew S. Tanenbaum, "Modern Operating Systems", 2nd Edition, Addison Wesley, 2001.
4. Pradeep K.Sinha, "Distributed operating system -Concepts and design", PHI, 2007.
5. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2013.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	1	-	2	2	-	-	2	-
2	3	-	3	3	1	-	3	2
3	3	-	3	3	2	-	3	2
4	3	-	3	3	3	2	3	2
5	2	-	3	3	1	-	2	1
CO (W.A)	2.4	-	2.8	2.8	1.75	2	2.6	1.75

22CPX06 – SEMANTIC WEB					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn fundamental concepts of semantic web.	**1.1**	The students will be able to understand the fundamental concepts of the semantic web.		
2.0	To know about different framework used in semantic web.	**2.1**	The students will be able to outline for semantic syntax and schema.		
3.0	To learn the methodologies of ontology.	**3.1**	The students will be able to design ontology using Web Ontology Language (OWL).		
4.0	To know about ontology management and tools used for Ontology annotation.	**4.1**	The students will be able to differentiate monotonic and non-monotonic rules.		
5.0	To comprehend the role of semantics in web services.	**5.1**	The students will be able to apply Semantic web technology to real world application		

UNIT I - INTRODUCTION	**(9)**
History – Semantic web layers – Semantic web technologies – Semantics in semantic web – XML – Structuring –Namespaces – Addressing – Querying – Processing XML.	
UNIT II – RDF AND QUERYING THE SEMANTIC WEB	**(9)**
RDF data model – syntax – Adding semantics – RDF schema – RDF and RDF schema in RDF schema – An axiomatic semantics for RDF and RDF schema – Querying in SPARQL.	
UNIT III – ONTOLOGY	**(9)**
Introduction – Ontology movement – OWL – OWL specification – OWL elements – OWL constructs – Simple and complex – Ontology engineering – Introduction – Constructing ontologies – Reusing ontologies – On-To-Knowledge semantic web architecture.	
UNIT IV – LOGIC AND INFERENCE	**(9)**
Logic – Description logics – Rules – Monotonic rules – syntax – semantics and examples – Non-monotonic rules –Motivation – syntax – Examples – Rule markup in XML– Monotonic rules – Non-Monotonic rules.	
UNIT V – APPLICATIONS OF SEMANTIC WEB TECHNOLOGIES	**(9)**
Case Study – Horizontal information products at Elsevier – Openacademia – Bibster – Data Integration at Audi – Skill finding at Swiss Life – Think tank portal at Enersearch – e-learning – web services – other scenarios.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Grigorous Antoniou and Van Hermelen, "A Semantic Web Primer", PHI Learning Private Limited, 2nd Edition, 2010.
2. James Hendler, Henry Lieberman and Wolfgang Wahlster, "Spinning the Semantic Web: Bringing the world wide web to its full potential", The MIT Press, 2005.
3. Shelley Powers, "Practical RDF", O'reilly publishers, 2009.
4. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, "Foundations of Semantic Web Technologies", Chapman & Hall/CRC, 2009.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	1	-	2	1	-	-	2	-
2	1	-	2	1	-	-	2	-
3	3	-	3	3	2	-	3	1
4	3	-	2	2	-	-	3	2
5	3	-	3	3	3	-	3	2
CO (W.A)	2.2	-	2.4	2	2.5	-	2.6	1.67

22CPX07 – DEEP LEARNING					
			L	T	P	C
			3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the concepts of Deep Learning.	**1.1**	The students will be able to Understand the basics concepts of deep learning		
2.0	To know about the deep neural networks	**2.1**	The students will adapt to the appropriate deep network architecture		
3.0	To appreciate the types of deep learning networks	**3.1**	The students will model different types of deep network with its functional components		
4.0	To understand the theoretical and practical aspects of CNN and RNN	**4.1**	The students will make use of CNN and RNN for modeling applications.		
5.0	To create the applications using deep learning concepts	**5.1**	The students will be able to know the various challenges involved in designing deep learning algorithms for varied applications.		

UNIT I - FOUNDATIONS OF DEEP LEARNING	**(9)**
Introduction – Math behind machine learning – Linear Algebra – Statistics –Machine Learning works – Logistic regression – Evaluating Models – Neural Networks – Training Neural Networks – Activation functions – Loss functions – Hyper parameters	
UNIT II – ARCHITECTURAL DESIGN	**(9)**
Defining Deep Learning – Common Architectural Principles of Deep Networks: Parameters – Layers - Activation functions - Loss functions - Optimization Algorithms – Hyper parameters. Building blocks of Deep Networks: RBMS - Auto encoders – Variational Auto encoders.	
UNIT III – TYPES OF DEEP NETWORKS	**(9)**
Unsupervised pre trained Networks – Convolutional Neural Networks (CNNs) – Recurrent Neural Networks – Recursive Neural Networks – Applications-About Deep Reinforcement Learning. Q-Learning-Implementation of linear regression technique-Program to create a multi-layer neural network	
UNIT IV – CONVOLUTIONAL AND RECURRENTNEURAL NETWORKS	**(9)**
Convolutional Neural Networks: Applying Pooling layers – Optimizing with Batch Normalization – Understanding padding and strides – Experimenting with Different types of initialization – Implementing a convolutional auto encoder – Applying a 1D CNN to text. **Recurrent Neural Networks**: Implementing a simple RNN – Adding LSTM – Using GRUs – Implementing Bidirectional RNNs- Character-level text generation.	

UNIT V – DEEP GENERATIVE MODELS	(9)
Deep Generative Models: Boltzmann Machines - Restricted Boltzmann Machines - Introduction to MCMC and Gibbs Sampling- gradient computations in RBMs - Deep Belief Networks- Deep Boltzmann Machines- Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing .	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Josh Patterson and Adam Gibson,"DeepLearning – A Practitioner'sApproach",1st Edition, O'Reilly Series, August2017
2. Indra den Bakker, "Python Deep Learning Cookbook", 1st Edition, Packt Publishing, October 2017.
3. Ian Good fellow, Yoshua Bengio and Aaron Courville, "Deep Learning", 1st Edition, MIT Press, 2016.
4. Nikhil Buduma, Nicholas Locascio " Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms" ,O' Reilly Media, Inc., May-2017

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	1	-	2	3	3	2
2	3	1	2	1	2	3	2	2
3	3	2	3	2	3	3	2	3
4	3	1	2	3	2	3	3	2
5	3	3	3	3	3	3	3	3
CO (W.A)	3	1.6	2.2	2.3	2.4	3	2.6	2.4

22CPX08 – DIGITAL IMAGE PROCESSING AND APPLICATIONS					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.	**1.1**	The students will be able to apply principles and techniques of digital image processing in applications related to digital image system design and analysis.		
2.0	To analyze and implement image processing algorithms.	**2.1**	The students will be able to acquire the fundamental concepts of a digital image processing system.		
3.0	To gain hands-on experience in using software tools for processing digital images.	**3.1**	The students will be able to analyze and implement image processing algorithms.		
4.0	To become familiar with image compression and segmentation techniques.	**4.1**	The students will be able to use image compression and segmentation techniques.		
5.0	To get exposed to the applications of Image Processing.	**5.1**	The students will be able to apply all image enhancement techniques.		

UNIT I - FUNDAMENTALS OF IMAGE PROCESSING	**(9)**
Introduction – Image Processing System – Steps in Image Processing Systems – Sampling and Quantization – Color Fundamentals and Models, File formats. Image Transforms: DFT, FFT, DCT, Walsh, Hadamard, Haar, Slant, KL and Radon Transforms.	
UNIT II – IMAGE ENHANCEMENT AND RESTORATION	**(9)**
Histogram processing – Fundamentals of Spatial Filtering – Histogram Processing – Smooth and Sharpening Spatial Filters. Filtering in Frequency Domain: Image Smoothing and Sharpening using Frequency Domain Filters: Noise Models – Inverse Filtering – Geometric Spatial transformation – image rest ration technique.	
UNIT III – IMAGE SEGMENTATION AND FEATURE ANALYSIS	**(9)**
Detection of Isolated Points – Line Detection – Edge Models – Edge Linking and Boundary Detection – Thresholding – Region based Segmentation – The use of motion in Segmentation – Feature analysis and Extraction.	
UNIT IV – MULTI RESOLUTION ANALYSIS AND COMPRESSIONS	**(9)**
Multi Resolution processing: Image pyramids – Sub band coding – Multi resolution Expansions - Wavelet Transform in one dimension and two dimensions – Wavelet Packets. Image Compression: Fundamentals – Models – Elements of Information theory – Lossy compression – Compression Standards – JPEG/MPEG.	

UNIT V – APPLICATIONS OF IMAGE PROCESSING	(9)
Representation and Description: Image Recognition – Image Understanding – Image Classification – Video Motion Analysis – Image Fusion – Image Steganography – Color Image Processing.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Rafael C. Gonzales, Richard E. Woods," Digital Image Processing", Pearson Education,3rd Edition, 2010.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt.Ltd,2011.
3. Jayaraman S., Esaki Rajan S., T. Veera Kumar, "Digital Image Processing", Tata McGraw Hill Pvt. Ltd., 2nd Reprint,2010.
4. Rafael C. Gonzales, Richard E. Woods, Steven L. Eddins," Digital Image Processing Using MATLAB", Tata McGraw Hill Pvt. Ltd., 3rd Edition, 2011.
5. Bhabatosh Chanda, Dwejesh Dutta Majumder," Digital Image Processing and analysis", PHI Learning Pvt. Ltd., 2nd Edition, 2011.
6. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", PHI Learning Pvt. Ltd., 1st Edition,2011.
7. Annadurai S., Shanmugalakshmi R., "Fundamentals of Digital Image Processing", Pearson Education, 1st Edition, 2007.
8. Web link :https://www.codecool.ir/extra/20208162046114111Digital.Image.Processing.4th.Edition.www.EBooksWorld.ir.pdf

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	-	1		1	1	2	2
2	1	-	3	2	1	1	1	1
3	3	-	3	3	2	1	2	2
4	3	-	3	3	2	1	2	2
5	3	-	3	3	2	1	2	2
CO (W.A)	2.4	-	2.6	2.75	1.6	1	1.8	1.8

22CPX09 – INFORMATION RETRIEVAL TECHNIQUES					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To gain knowledge of the basics of Information Retrieval with pertinence to modeling,	**1.1**	The student will be able to apply the basics of Information Retrieval with pertinence to various modeling		
2.0	To learn about the various components of an Information Retrieval system	**2.1**	The student will be able to design the various components of an Information Retrieval system		
3.0	To be familiar with query operations and indexing	**3.1**	The student will be able to describe indexing and query properties		
4.0	To explore the machine learning techniques for text classification and clustering which is used for efficient Information Retrieval	**4.1**	The student will be able to apply machine learning techniques for text classification and clustering which is used for efficient Information Retrieval		
5.0	To understand the various applications of Information Retrieval giving emphasis to Multimedia IR, Web Search and digital libraries	**5.1**	The student will be able to analyze the Web content structure and Design an efficient search engine		

UNIT I - INTRODUCTION	**(9)**
Motivation – Basic Concepts – Practical Issues - Retrieval Process – Architecture – Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems– History of Web Search – Web Characteristics–The impact of the web on IR—IR Versus Web Search–Components of a Search Engine.	
UNIT II – MODELING	**(9)**
Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting –Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models –Algebraic Models – Structured Text Retrieval Models – Models for Browsing.	
UNIT III – INDEXING	**(9)**
Static and Dynamic Inverted Indices – Index Construction and Index Compression Searching -Sequential Searching and Pattern Matching. Query Operations - Query Languages– Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis –Measuring Effectiveness and Efficiency.	
UNIT IV – CLASSIFICATION AND CLUSTERING	**(9)**
Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning.	

UNIT V – SEARCHING AND RANKING	(9)
Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking -Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Christopher D. Manning, PrabhakarRaghavan, HinrichSchutze, "Introduction to Information Retrieval", Cambridge University Press, First South Asian Edition 2012.
2. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval Implementing and Evaluating Search Engines", The MIT Press, Cambridge, Massachusetts, London, England, 2016.
3. Ricardo Baeza – Yates, BerthierRibeiro – Neto, "Modern Information Retrieval: The concepts and Technology behind Search", Addison Wesley, USA, 2012.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	-	2	3	-	3	2
2	3	2	1	2	3	-	3	2
3	-	-	1	-	-	1	3	3
4	3	3	2	2	3	2	3	3
5	3	3	-	2	3	-	3	3
CO (W.A)	3	2.5	1.33	2	3	1.5	3	2.6

22CPX10 – WEB SERVICES					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To employ basic XML specifications, technologies and applications.	**1.1**	The student will be able to analyze a web page and identify its elements and attributes.		
2.0	To understand about the XML schema and query.	**2.1**	The student will be able to Relate to XML Presentation Oriented Publishing (POP) applications and XML Message Oriented Middleware (MOM) applications		
3.0	To learn about SOAP and WSDL implementations.	**3.1**	The student will be able to develop web services using SOAP and WSDL technologies.		
4.0	To describe web service, supporting specifications and technologies including SOAP and UDDI,JAX-RPC.	**4.1**	The student will be able to build and consume web services using SOAP and UDDI, JAX-RPC.		
5.0	To learn to develop applications using JAX and RPC.	**5.1**	The student will be able to implement client server applications using JAX and RPC.		

UNIT I - XML	**(9)**
XML Basis – XML Namespace – Working with DTD: Validating your XML document – Defining DTD Entities – Working with Attributes – Adding Style – XSL Transformations.	
UNIT II – XML SCHEMA AND QUERY	**(9)**
Using Schema: Schema Elements, Types and Groups – Defining Schema Attributes – XML Query – XLink – XPointer.	
UNIT III – WEB SERVICES: SOAP & WSDL	**(9)**
Web Services SOAP: – Structure of SOAP – SOAP Namespaces – SOAP Headers – SOAP Body – SOAP Messaging Modes – SOAP Faults – SOAP over HTTP. WSDL: Structure of WSDL – WSDL Declarations – WSDL Abstract Interface – Messaging Exchange patterns – WSDL Implementation.	
UNIT IV – WEB SERVICES: UDDI	**(9)**
UDDI: Introduction – Data structures – Business Entity Structure - Business Service and Binding Template Structures – tModel Structure – UDDI Inquiry API – Operations – UDDI Publishing API.	
UNIT V – WEB SERVICES: JAX – RPC	**(9)**
JAX- RPC: Overview – JAX-RPC Service Endpoints – JAX-RPC EJB Endpoints - JAX-RPC Clients APIs. SAAJ: Creating a SOAP Message – Working with SOAP Documents – Working with SOAP Faults – Sending SOAP messages with SAAJ.	
	TOTAL (L:45) : 45 PERIODS

REFERENCES :

1. Richard Monson-Haefel, "J2EE Web Services", 8th Edition, Person Education, 2012.
2. D.A. Chappell & T. Jewell "Java Web Services", O'Reilly,SPD
3. G. Alonso, F. Casati and others,"Web Services" ,Springer, 2005
4. Heather Williamson, "The Complete Reference XML", TMH, 2001.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	3	2	-	2	3	-	3	3
2	3	2	1	2	3	-	3	3
3	-	-	1	-	-	1	3	3
4	3	3	2	2	3	2	3	3
5	3	3	-	2	3	-	3	3
CO (W.A)	3	2.5	1.33	2	3	1.5	3	3

22CPX11 – MOBILE APPLICATION DEVELOPMENT					
			L	T	P	C
			3	0	0	3
PREREQUISITE : 22CPB01					
Course Objectives		**Course Outcomes**			
1.0	To understand system requirements for mobile applications.	**1.1**	The students will be able to describe the requirements for mobile applications		
2.0	To learn suitable design using specific mobile development frameworks.	**2.1**	The students will be able to explain the challenges in mobile application design and development.		
3.0	To create mobile application design.	**3.1**	The students will be able to design mobile applications for specific requirements.		
4.0	To understand the design using specific mobile development frameworks.	**4.1**	The students will be able to develop the design using Android SDK and iOS SDK.		
5.0	To know the latest technologies available in mobile application.	**5.1**	The students will be able to deploy mobile applications in Android and iPhone.		

UNIT I - INTRODUCTION	**(9)**
Introduction to mobile applications – Importance of mobile strategies – Cost of development – Mobile myths – Market and business drivers for mobile applications – Mobile web presence – Mobile applications – Benefits of a mobile app	
UNIT II – BASIC DESIGN	**(9)**
Introduction– Mobile user interface design–Understanding mobile application users–Understanding mobile information design – Understanding mobile platforms – Using the tools of mobile interface design.	
UNIT III – ADVANCED DESIGN	**(9)**
Choosing a mobile web option – Adaptive mobile websites – Dedicated mobile websites – Mobile web apps with HTML5 – Design patterns for mobile applications – Using Intent Filter, Permissions.	
UNIT IV – DEVELOPMENT ENVIRONMENT	**(9)**
Android development practices – Android fundamentals – Android SDK – Common interactions– Offline storage – iOSSDK– Debugging iOS apps – Objective -C basics – iOS features.	
UNIT V – TECHNOLOGY	**(9)**
Android development practices -Anatomy of Android applications – Android SDK – Common interactions– Offline storage – iOSSDK– Debugging iOS apps – Objective -C basics – iOS features.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
2. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012.
3. James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012.
4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.
5. http://developer.android.com/develop/index.html.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	1	3	3			2	2	2
2	3	1	1	3	3	1	2	2
3	1	3	-	2	3	-	2	2
4	0	-	-	1	2	-	-	2
5	1	-	-	-	2	-	-	-
CO (W.A)	1.5	2.33	2	2	2.5	1.5	2	2

22CPX12 – WIRELESS SENSOR NETWORKS					
		L	T	P	C
		3	0	0	3
PREREQUISITE : 22CPB01					
Course Objectives		**Course Outcomes**			
1.0	To learn the basics of wireless sensor network	**1.1**	The students will be able to explain about the various applications, Constraints and Challenges of wireless sensor networks.		
2.0	To enhance the working knowledge on Localization and Tracking.	**2.1**	The students will be able to work on Localization and Tracking		
3.0	To gain knowledge on various routing protocols.	**3.1**	The students will be able to use suitable routing protocols for specific application.		
4.0	To learn about Sensor Network Databases.	**4.1**	The students will be able to develop applications on wireless motes, smart phones and other embedded platforms.		
5.0	To know recent Tools and Techniques for real time application.	**5.1**	The students will be able to identify suitable tools and techniques for sensor network applications		

UNIT I - INTRODUCTION TO SENSOR NETWORKS	**(9)**
Background of Sensor Network Technology and Their Applications – Constraints and Challenges – Collaborative Processing – Basic Sensor Network Architectural Elements – Basic Wireless Sensor Technology – Hardware Components – Operating System and Execution Environment – Comparison of Wireless Sensor Networks with Mobile Adhoc Networks.	
UNIT II – LOCALIZATION AND TRACKING	**(9)**
Tracking Scenario – Problem Formulation – Distributed Representation and Interface of States – Tracking Multiple Objects – Sensor Models – Performance Comparison and Metrics.	
UNIT III – NETWORK STANDARDS AND ROUTING PROTOCOLS	**(9)**
The SMAC Protocol – IEEE 802.15.4 Standard and ZigBee – Routing challenges and design issues in Wireless Sensor Network – Energy Efficient Unicast Routing – Geographical Routing.	
UNIT IV – SENSOR NETWORK DATA BASES	**(9)**
Sensor Data base challenges–Querying the Physical Environment – Query Interfaces – High level Data Base Organization – Network aggregation – TinyDB Query Processing – Data Centric Storage – Data indices and Range Queries – Distributed Hierarchical Aggregation.	
UNIT V – SENSOR NETWORK PLATFORMS AND TOOLS	**(9)**
Sensor Node Hardware – Berkeley Motes – Programming Challenges– Node-level Software Platforms – Node-level Simulators – State-centric Programming – Emerging Applications of Wireless Sensor Networks – Case study using SENSE	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. F. Zhao and L. Guibas, "Wireless Sensor Network: Information Processing Approach", Elsevier, 2009.
2. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", Elsevier, 2011.
3. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks - Technology, Protocols, and Applications", John Wiley, 2007.
4. E. H. Callaway, Jr. E. H. Callaway, "Wireless Sensor Networks Architecture and Protocols", CRC Press, 2009

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	-	2	2	2	-	3	2
2	3	-	3	3	3	-	2	2
3	3	-	3	3	3	1	3	3
4	3	-	3	3	3	1	3	3
5	3	-	3	3	2	-	3	2
CO (W.A)	2.8	-	2.8	2.8	2.6	1	2.8	2.4

22CPX13 – NATURAL LANGUAGE PROCESSING					
			L	**T**	**P**	**C**
			3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To provide an introduction to the central issues of Natural Language Processing (NLP).	**1.1**	Attain fundamental knowledge in natural language processing.		
2.0	To Study the morphological approaches.	**2.1**	Demonstrate an understanding of Morphology and Part of Speech Tagging.		
3.0	To Outline different speech techniques.	**3.1**	Familiarize with techniques used for speech recognition.		
4.0	To explore semantics of words and semantic role labeling of sentences.	**4.1**	Explain the use of semantic analysis methods.		
5.0	To Provide an introduction to advanced topics.	**5.1**	Make use of Computation Phonology and HMM for Speech recognition and Text to Speech conversion.		

UNIT I - INTRODUCTION AND WORDS	**(9)**
Knowledge in speech and language processing – Ambiguity – Models and algorithms –Language, Thought and understanding – History of NLP -Regular expressions and automata – Words and transducers: Finite-state transducers – FSTs formorphological parsing - Human morphological processing	
UNIT II – MORPHOLOGY AND PARTS OF SPEECH TAGGING	**(9)**
Morphology and Finite State Transducers-N-grams and Language Models- Part of speech Tagging-Rule-Based Part of Speech Tagging- Stochastic Part of Speech Tagging -Markov Models- Hidden Markov Models– Transformation based Models-Maximum Entropy Models.	
UNIT III – SPEECH	**(9)**
Phonetics: Speech sounds and phonetic transcription – Articulatory phonetics– Speech synthesis: Text normalization - Automatic speech recognition: Speech recognition architecture – Applying the hidden markov model to speech – Computational phonology: Syllabification – Learning phonology and morphology	
UNIT IV – SEMANTIC ANALYSIS	**(9)**
Semantic analysis-Syntax driven semantic analysis-Lexical semantics–Word-sense disambiguation-Supervised–Dictionary based and Unsupervised Approaches- Compositional semantics-Semantic role labeling and Semantic parsing– Discourse analysis.	

UNIT V – ADVANCED TOPICS	(9)
Computational Phonology - HMM and Speech Recognition – Discourse - Dialogue and Conversation - Deep Learning and Natural Language Processing.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Daniel Jurafsky and James H. martin, "Speech and Language Processing", 2nd Edition,Pearson Higher Education, 2009.
2. Li Deng and Yang Liu, " Deep Learning in Natural Language Processing",1st Edition, Springer,2018
3. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019
4. Daniel Bikel and ImedZitouni, "Multilingual Natural Language Processing Applications:From Theory to Practice", IBM Press.
5. Christopher Manning and HinrichSchuetze," Foundations of Statistical Natural Language Processing", 1st Edition, MIT Press.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	-	1	2	2	2	2	1	2
2	2	3	3	2	2	1	2	2
3	-	3	2	2	3	2	2	1
4	2	1	2	3	2	3	3	2
5	3	-	2	3	3	2	2	3
CO (W.A)	2.3	2	2.2	2.4	2.4	2	2	2

22CPX14 – GPU COMPUTING					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : Basic Programming Skills, Basic of Computer Graphics					
Course Objectives		**Course Outcomes**			
1.0	To Comprehend commonly used terms in parallel computing.	**1.1**	The students will be able to define terminology commonly used in parallel computing, such as efficiency and speedup.		
2.0	To Understand the GPU architectures and Programming Models.	**2.1**	The students will be able to describe common GPU architectures and programming models		
3.0	To build an algorithms efficiently for common application kernels.	**3.1**	The students will be able to implement efficient algorithms for common application kernels, such as matrix multiplication.		
4.0	To learn the development of an efficient parallel algorithms to solve given problems.	**4.1**	The students will be able to develop an efficient parallel algorithm to solve a given problem.		
5.0	To learn to Develop solutions to solve computationally intensive problems in various fields	**5.1**	The students will be able to implement an efficient and correct code to solve a given problem, analyze its performance, and give convincing written and oral presentations explaining the achievements		

UNIT I - INTRODUCTION	**(9)**
History, GPU Architecture, Clock speeds, CPU/ GPU comparisons, Heterogeneity, Accelerators, Parallel Programming, CUDA OpenCL/ OpenACC, Kernels Launch parameters, Thread hierarchy, Warps/Wavefronts, Threadblocks/Workgroups, Streaming multiprocessors, 1D/2D/3D thread mapping, Device properties, Simple Programs.	
UNIT II – MEMORY	**(9)**
Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories	
UNIT III – SYNCHRONIZATION	**(9)**
Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU. Functions:Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.	
UNIT IV – SUPPORT AND STREAM	**(9)**
Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects. Streams:Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.	

UNIT V – ADVANCED TOPICS	(9)
Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing. Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Wen-meiHwu, David Kirk, Izzat El Hajj, "Programming Massively Parallel Processors: A Hands-On Approach", 4th Edition, Publisher: Morgan Kaufman, 2022.
2. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufman; 2014.
3. Wilkinson, M.Allen, "Parallel Programming Techniques and Applications using networked workstations and parallel computers", 2nd Edition, Prentice Hall, 2004.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	-	-	2	3	3	3	2
2	3	2	2	2	3	3	3	2
3	-	-	2	-	-	2	3	3
4	3	2	3	2	3	2	3	3
5	3	3	-	2	3	2	3	3
CO (W.A)	3	2.33	2.33	2	3	2.40	3	2.6

22CPX15 – COMPILER CONSTRUCTION AND OPTIMIZATION					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the optimization techniques used in compiler design.	**1.1**	The students will be able to design Compilers for a programming language.		
2.0	To be aware of the various computer architectures that support parallelism.	**2.1**	The students will be able to map the process of Compilation for a programming paradigm and design compiler for the same.		
3.0	To become familiar with the theoretical background needed for code optimization.	**3.1**	The students will be able to data log Implementation leads to a more efficient implementation of the dataflow analysis.		
4.0	To understand the techniques used for identifying parallelism in a sequential program.	**4.1**	The students will be able to combine different optimization techniques to achieve the overall objective of program efficiency.		
5.0	To learn the various optimization algorithms	**5.1**	The students will be able to explore on inter procedural analysis techniques.		

UNIT I - INTRODUCTION	**(9)**
Language Processors - The Structure of a Compiler – The Evolution of Programming Languages The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator -Parser Generator - Overview of Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Principle Sources of Optimization.	
UNIT II – INSTRUCTION-LEVEL PARALLELISM	**(9)**
Processor Architectures – Code-Scheduling Constraints – Basic-Block Scheduling – Global Code Scheduling – Software Pipelining.	
UNIT III – OPTIMIZING FOR PARALLELISM AND LOCALITY-THEORY	**(9)**
Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse Array data dependence Analysis.	
UNIT IV – OPTIMIZING FOR PARALLELISM AND LOCALITY – APPLICATION	**(9)**
Finding Synchronization – Free Parallelism – Synchronization between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms.	
UNIT V – INTERPROCEDURAL ANALYSIS	**(9)**
Basic Concepts – Need for Interprocedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Interprocedural Analysis - Context Sensitive Pointer-Analysis – Datalog Implementation by Binary Decision Diagrams.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers: Principles, Techniques and Tools", 2nd Edition., Pearson Education,2008.
2. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", Morgan Kaufmann Publishers, 2002.
3. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers Elsevier Science, India, Indian Reprint 2003.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	-	3	3	-	1	3	2
2	2	-	3	3	1	2	3	-
3	3	-	3	3	-	1	3	1
4	3	-	3	3	1	1	3	1
5	3	-	3	3	-	-	3	-
CO (W.A)	2.6	-	3	3.	1	1.25	3	1.33

22CPX16 – BLOCKCHAIN TECHNOLOGIES					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To study the basics of Blockchain technology.	**1.1**	The students will be able to understand and explore the working of Blockchain technology		
2.0	To explore various aspects of Bitcoin And Cryptocurrency	**2.1**	The students will be able to analyze the working of Smart Contracts		
3.0	To study the working of Ethereum	**3.1**	The students will be able to apply the learning of solidity to build de-centralized apps on Ethereum		
4.0	To study the working of Hyperledger & Solidity Programming	**4.1**	The students will be able to understand and analyze the working of Hyperledger		
5.0	To have an idea about private and public Blockchain, and smart contract.	**5.1**	The students will be able to develop applications on Blockchain		

UNIT I - INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN	**(9)**
Blockchain introduction– Blockchain Technology Mechanisms and Networks –Blockchain Origins – Objective of Blockchain – Blockchain Challenges – Transactions and Blocks – P2P Systems – Keys as Identity – Digital Signatures – Hashing – public key cryptosystems – private vs. public Blockchain	
UNIT II – BITCOIN AND CRYPTOCURRENCY	**(9)**
Bitcoin – The Bitcoin Network – The Bitcoin Mining Process – Mining Developments – Bitcoin Wallets – Decentralization and Hard Forks – Ethereum Virtual Machine (EVM) – Merkle Tree – DoubleSpend Problem – Blockchain and Digital Currency – Transactional Blocks – Impact of Blockchain Technology on Cryptocurrency	
UNIT III – INTRODUCTION TO ETHEREUM	**(9)**
Introduction to Ethereum – Consensus Mechanisms – Metamask Setup – Ethereum Accounts – Transactions – Receiving Ethers – Smart Contracts	
UNIT IV –INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING	**(9)**
Introduction to Hyperledger – Distributed Ledger Technology and its Challenges – Hyperledger & Distributed Ledger Technology – Hyperledger Fabric – Hyperledger Composer – Solidity – Language of Smart Contracts – Installing Solidity and Ethereum Wallet – Basics of Solidity – Layout of a Solidity Source File and Structure of Smart Contracts – General Value Types.	
UNIT V – BLOCKCHAIN APPLICATIONS	**(9)**
Internet of Things – Medical Record Management System – Domain Name Service and Future of Blockchain – Alt Coins	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", 2nd Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016.
3. Antonopoulos, "Mastering Bitcoin", O'Reilly Publishing, 2014.
4. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.
5. D. Drescher, "Blockchain Basics", Apress, 2017.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	-	3	3	2	2	3	3
2	3	-	3	3	2	2	3	3
3	3	-	3	3	2	2	3	3
4	3	-	3	3	2	2	3	3
5	3	-	3	3	2	2	3	3
CO (W.A)	3	-	3	3	2	2	3	3

22CPX17 – PATTERN RECOGNITION					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To acquire knowledge on the pattern classifier.	**1.1**	Explain about the pattern recognition problems.		
2.0	To know about classification problems classifier performance.	**2.1**	Build appropriate clustering techniques for various problems with high dimensional data.		
3.0	To describe the various structural pattern recognition techniques.	**3.1**	Gain insight into the principles and commonly used grammars for structural pattern recognition.		
4.0	To perceive knowledge on basic feature extraction techniques.	**4.1**	Analyze about feature extraction and subset selection methods for various real world applications.		
5.0	To learn about recent advancements in pattern recognition.	**5.1**	Experiment with tools used to study complexity, including evolutionary computing and Fuzzy logic.		

UNIT I - PATTERN CLASSIFIER	**(9)**
Overview of pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum likelihood estimation – Bayesian parameter estimation – Perception algorithm – LMSE algorithm – Problems with Bayes approach – Pattern classification by distance functions – Minimum distance pattern classifier.	
UNIT II – UNSUPERVISED CLASSIFICATION	**(9)**
Clustering for unsupervised learning and classification – Clustering concept – C-means algorithm – Hierarchical clustering procedures – Graph theoretic approach to pattern clustering – Validity of clustering solutions.	
UNIT III – STRUCTURAL PATTERN RECOGNITION	**(9)**
Elements of formal grammars – String generation as pattern description – Recognition of syntactic description – Parsing – Stochastic grammars and applications – Graph based structural representation.	
UNIT IV – FEATURE EXTRACTION AND SELECTION	**(9)**
Entropy minimization – Karhunen – Loeve transformation – Feature selection through functions approximation – Binary feature selection.	
UNIT V – RECENT ADVANCES	**(9)**
Neural network structures for Pattern Recognition – Neural network based Pattern associators – Unsupervised learning in neural Pattern Recognition – Self-organizing networks – Fuzzy logic – Fuzzy pattern classifiers – Pattern classification using Genetic Algorithms.Casestudy : Web Applications- Medical Applications.	
	TOTAL (L:45) : 45 PERIODS

REFERENCES :

1. Robert J.Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, 2017.
2. Tou and Gonzales, "Pattern Recognition Principles", Wesley Publication Company, London, 2012.
3. Duda R.O., and Har P.E., "Pattern Classification and Scene Analysis", Wiley, NewYork, 2008.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3		-	2	3	3	3	2
2	3	2	1	2	3	3	3	2
3	-	-	1	-	-	2	3	3
4	3	2	2	2	3	2	3	3
5	3	3	-	2	3	2	3	3
CO (W.A)	3	2.33	1.33	2	3	2.4	3	2.6

22CPX18 – VIRTUALIZATION TECHNIQUES					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To learn basics of virtualization.	**1.1**	The students will be able to understand the main concepts, key technologies, strengths, and limitations of virtualization.		
2.0	To study how to allocate memory in different environment.	**2.1**	The students will be able to develop the infrastructure of interfacing, including public cloud, private cloud, and hybrid cloud.		
3.0	To know the virtual infrastructure management.	**3.1**	The students will be able to manage capabilities for planning, deploying, managing, and optimizing virtual infrastructure.		
4.0	To learn how effectively migrate a running production in virtual machine.	**4.1**	The students will be able to solve the appropriate machine learning solutions and then recommend.		
5.0	To get knowledge about virtual server	**5.1**	The students will be able to apply the Microsoft Virtual Server Environment in virtual machine.		

UNIT I - OVERVIEW OF VIRTUALIZATION	**(9)**
Basics of Virtualization – Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization – System-leveler Operating Virtualization – Application Virtualization–Virtualization Advantages –Virtual Machine:CPU virtualization –Privileged instructions handling – Hypervisor –Para virtualization– Hardware Assisted virtualization – Booting up – Time keeping – CPU scheduling –Commercial examples.	
UNIT II – MEMORY SERVER CONSOLIDATION	**(9)**
Hardware Virtualization – Virtual Hardware Overview – Sever Virtualization – Physical and Logical Partitioning – Types of Server Virtualization – Business cases for Sever Virtualization – Uses of Virtual server Consolidation –Partitioning – Reclamation – Ballooning – Memory sharing – OS level virtualization –VM Ware –Red Hat Enterprise Virtualization.	
UNIT III – NETWORK VIRTUALIZATION	**(9)**
Design of Scalable Enterprise Networks – Virtualizing the Campus WAN Design – WAN Architecture – WAN Virtualization – Virtual Enterprise Transport Virtualization–VLANs and Scalability – Theory Network Device Virtualization Layer 2 – VLANs Layer3 VRF Instances Layer 2 – VFIs Virtual Firewall Contexts Network Device Virtualization – Data- Path Virtualization Layer 2: 802.1q – Trunking Generic Routing Encapsulation –IPsecL2TPv3 Label Switched Paths – Control-Plane Virtualization–Routing Protocols– VRF – Aware Routing Multi–Topology Routing.	

UNIT IV – I/O VIRTUALIZING STORAGE	(9)
SCSI– Speaking SCSI– Using SCSI buses – Fiber Channel – Fiber Channel Cables –Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI – SAN backup and recovery techniques – RAID – SNIA Shared Storage Model – Classical Storage Model – SNIA Shared Storage Model – Host based Architecture – Storage based architecture – Network based Architecture– Fault tolerance to SAN – Performing Backups – Virtual tape libraries.	
UNIT V – VIRTUALIZEDMACHINE COMPUTING	**(9)**
Xen Virtual machine monitors– Xen API – VMware – VMware products – VMwareFeatures – Microsoft Virtual Server – Features of Microsoft Virtual Server–Virtual machine based distributed computing, elastic cloud computing, clustering, cold and hot migration – Commercial examples – Challenges and future trends.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. William von Hagen, "Professional Xen Virtualization", Wrox Publications, January, 2008.
2. Jim Smith, "Virtual Machines: Versatile Platforms for Systems and Processes", Auerbach Publications, 2005.
3. Chris Wol,, " Virtualization: From the Desktop to the Enterprise", Apress Publications, 1st Edition 2005.
4. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann Publications, 2005.
5. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	1	-	2	2	2	2	1
2	2	-	2	2	2	-	1	2
3	-	1	-	3	2	3	3	2
4	2	2	2	3	3	-	2	2
5	3	2	3	3	3	-	3	2
CO (W.A)	**2.5**	**1.5**	**2.3**	**2.6**	**2.4**	**2.5**	**2.2**	**1.8**

22CPX19 – QUANTUM COMPUTING					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the fundamental concepts of Quantum computing.	**1.1**	Able to understand the basic principles of quantum computing.		
2.0	To explore the quantum mechanics and computational models.	**2.1**	The students will be able to analyze the mathematical framework of quantum mechanics and computational models.		
3.0	To understand the concepts of Quantum Computing and algorithms.	**3.1**	The students will be able to understand the basic several Quantum Computing algorithms.		
4.0	To understand the various quantum operations.	**4.1**	Able to understand the classes of problems that can be expected to be solved well be quantum computers.		
5.0	To understand the various quantum information techniques.	**5.1**	The student will be able to analyze the various compression techniques.		

UNIT I - FUNDAMENTAL CONCEPTS	**(9)**
Global Perspectives – Quantum Bits – Quantum Computation – Quantum Algorithms – Experimental Quantum Information Processing – Quantum Information.	
UNIT II – MECHANICS AND COMPUTATIONAL MODELS	**(9)**
Quantum Mechanics: Linear Algebra – Postulates of Quantum Mechanics – Application: Super dense Coding – Density Operator – The Schmidt Decomposition and Purifications – EPR and the Bell Inequality – Computational Models: Turing Machines – Circuits – Analysis of Computational Problems.	
UNIT III – QUANTUM COMPUTATION AND ALGORITHMS	**(9)**
Quantum Circuits: Quantum Algorithms – Universal Quantum Gates – Quantum Circuit Model of Computation – Simulation – Quantum Fourier Transform and its Applications – Quantum Search Algorithms – Quantum Computers	
UNIT IV – QUANTUM INFORMATION	**(9)**
Quantum Noise and Quantum Operations: Classical Noise and Markov processes – Quantum Operations – Examples – Applications – Distance Measures for Quantum Information – Quantum Error Correction – Entropy	
UNIT V – QUANTUM INFORMATION THEORY	**(9)**
Quantum States and Accessible Information – Data Compression – Classical and Quantum Information Over Noisy Quantum Channels – Quantum Cryptography.	
TOTAL (L:45) : 45 PERIODS	

REFERENCES :

1. Michael A. Nielsen, Isaac L. Chuang, "Quantum Computation and Quantum Information", 10th Edition, Cambridge University Press, 2010.
2. Scott Aaronson," Quantity Computing Since Democritus", Cambridge University Press, April 2013.
3. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

Mapping of COs with POs / PSOs								
COs	**POs**						**PSOs**	
	1	2	3	4	5	6	1	2
1	1	3	1	2	2	2	1	2
2	1	-	2	1	1	3	1	2
3	3	2	2	3	2	2	2	3
4	2	-	2	2	3	1	3	2
5	2	2	3	3	2	2	2	3
CO (weighted average)	**1.8**	**2.3**	**2**	**2.2**	**2**	**2**	**1.8**	**2.4**

22BAZ01 - RESEARCH METHODOLOGY AND IPR					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the basic concepts of research and its methodologies, investigation of solutions for research problem, data collection, analysis and interpretation.	**1.1**	Demonstrate the concepts of research and its methodologies, Approaches of information investigation of solutions for research problem, data collection, analysis and interpretation.		
2.0	To identify the various procedures to collect literature studies approaches analysis, plagiarism, and research ethics.	**2.1**	Formulate effective literature studies approaches, analysis, plagiarism, and research ethics.		
3.0	To inculcate knowledge on Effective technical writing and method to write report.	**3.1**	Identify the design for Effective technical writing and how to write report.		
4.0	To provide knowledge process like drawing and drafting tools and reviewing research papers.	**4.1**	Choose the process like drawing and drafting tools and reviewing research papers.		
5.0	To summarize the design for Intellectual property rights and code of ethics.	**5.1**	Formulate the design for Intellectual property rights and code of ethics.		

UNIT I - RESEARCH PROBLEM FORMULATION	**(9)**
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.	
UNIT II - LITERATURE REVIEW	**(9)**
Effective literature studies approaches, analysis, plagiarism, and research ethics	
UNIT III - TECHNICALWRITING /PRESENTATION	**(9)**
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.	
UNIT IV - INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)	**(9)**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	

UNIT V - INTELLECTUAL PROPERTY RIGHTS (IPR)	(9)
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOK:

1. Cooper, D. R. and Schindler, P. S., (2009), "Business Research Methods", Tata McGraw Hill, 9th Edition.
2. Krishnaswamy, K.N., Sivakumar, A.I., and Mathirajan, M., "Management Research Methodology", Pearson Education, 2006.
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.

REFERENCES :

1. Jackson, S.L., "Research Methods and Statistics", Cengage Learning India Private Limited, New Delhi, 2009
2. Lebrun, J-L., "Scientific Writing: A Reader and Writer's Guide", World Scientific Publishing Co. Pte. Ltd., Singapore, 2007.
3. Nicholls, David G, "MLA Handbook for Writers of Research papers", 7th Edition, Affiliated East West Press Pvt Ltd, New Delhi, 2009.
4. Thiel, D. V., "Research Methods for Engineers", Cambridge University Press, 2014.
5. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners" 2nd Edition, 2010.

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	1	1	2	1	3	-
2	2	3	2	1	-	-	2	1
3	2	3	2	2	1	1	2	1
4	1	3	2	2	2	1	1	2
5	1	1	2	3	2	2	1	2
CO (weighted average)	1.8	2.4	1.8	1.8	1.75	1.25	1.8	1.5

22CPZ01- MACHINE VISION					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To know the basics of machine vision and computer vision.	**1.1**	The student will be able to apply the vision concepts in various mechatronics applications.		
2.0	To study the image acquisition techniques.	**2.1**	The student will be able to recognize the Image acquisition techniques and tools.		
3.0	To learn the image processing methods.	**3.1**	The student will be able to apply the image processing tools and libraries.		
4.0	To understand the methods used for image analysis.	**4.1**	The student will be able to analyze the images in the case of Robotic or IoT applications.		
5.0	To gain exposure on Image processing applications.	**5.1**	The student will be able to select the right machine vision system for implementing in industrial applications.		

UNIT I - INTRODUCTION	**(8)**
Human vision – Machine vision and Computer vision – Benefits of machine vision – Block diagram and function of machine vision system implementation of industrial machine vision system – Physics of Light – Interactions of light – Refraction at a spherical surface.	
UNIT II - IMAGE ACQUISITION	**(12)**
Scene constraints – Lighting parameters – Lighting sources, Selection – Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras – Digital Camera Interfaces – Camera Computer Interfaces, Specifications and election – Geometrical Image formation models – Camera Calibration.	
UNIT III - IMAGE PROCESSING	**(10)**
Machine Vision Software – Fundamentals of Digital Image – Image Acquisition Modes – Image Processing in Spatial and Frequency Domain – Point Operation, Thresholding, Grayscale Stretching – Neighborhood Operations, Image Smoothing and Sharpening – Edge Detection –Binary Morphology – Color image processing.	
UNIT IV - IMAGE ANALYSIS	**(6)**
Feature extraction – Region Features, Shape and Size features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.	

UNIT V - MACHINE VISION APPLICATIONS	(9)
Machine vision applications in manufacturing, electronics, printing, pharmaceutical, textile, applications in non-visible spectrum, metrology and gauging, OCR and OCV, vision guided robotics – Field and Service Applications – Agricultural, and Bio medical field, augmented reality, surveillance, bio-metrics.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOK:

1. D. A. Forsyth and J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2015.
2. R. Jain, R. Kasturi and B. G. Schunck, "Machine Vision", McGraw-Hill, 1995.
3. Dana H. Ballard & Christopher M. Brown, "Computer Vision", Prentice-Hall, 1982.
4. Alexander Hornberg, "Handbook of Machine Vision", 1st Edition,Wiley 2007.
5. Emanuele Trucco, Alessandro Verri, "Introductory Techniques For 3D Computer Vision", Prentice Hall,2006

Mapping of COs with POs / PSOs

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3	2	-	1	1	3	2	2
2	3	2	2	1	1	3	2	2
3	3	2	3	2	1	3	2	3
4	3	2	2	1	1	3	2	2
5	3	3	3	3	3	3	3	3
CO (weighted average)	3	2.2	2.5	1.6	1.4	3	2.2	2.4

22PGA01- ENGLISH FOR RESEARCH PAPER WRITING					
			L	**T**	**P**	**C**
			2	**0**	**0**	**0**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To make the students to improve writing skills and level of readability	**1.1**	The students will be able to improve writing skills and level of readability		
2.0	To explain the strategic planning process and apply different presentation method	**2.1**	The students will be able to describe what to write in each section		
3.0	To foster the ability to understand and to utilize the mechanics of writing.	**3.1**	The students will be able to explain the skills needed for writing quality research paper		
4.0	To Infer the skills needed when writing the Conclusion	**4.1**	The students will be able to explore the recent areas of research		
5.0	To focus research and its key variables, guiding through research process	**5.1**	The students will be able to illustrate the good quality of paper at very first-time submission		

UNIT I - INTRODUCTION	**(6)**
Planning and Preparation - Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	
UNIT II – PRESENTATION SKILLS	**(6)**
Clarifying Who Did What- Highlighting Findings - Hedging and Criticizing- Paraphrasing - Sections of a Paper – Abstracts – Introduction.	
UNIT III – MECHANICS OF RESEARCH	**(6)**
Key skills needed for writing - Title, Abstract, Introduction, Discussion, Conclusion, The Final Check.	
UNIT IV – PROCESS OF RESEARCH WRITING	**(6)**
Skills needed for writing Methods - skills needed when writing Results - skills needed when writing Discussion - skills needed when writing Conclusion.	
UNIT V – QUALITY RESEARCH PAPER	**(6)**
Useful phrases, Checking Plagiarism - Bibliography- Citation- how to ensure paper is as good as it could possibly be the first- time submission.	
TOTAL (L:30) : 30 PERIODS	

REFERENCES :

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

22PGA02 - DISASTER MANAGEMENT					
		L	T	P	C
		2	0	0	0
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To Summarize basics of disaster.	**1.1**	Ability to summarize basics of disaster.		
2.0	To Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.	**2.1**	Ability to explain a critical understanding of key concepts in disaster risk reduction and Humanitarian response.		
3.0	To Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	**3.1**	Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.		
4.0	To Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	**4.1**	Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.		
5.0	To Develop the strengths and weaknesses of disaster management approaches.	**5.1**	Ability to develop the strengths and weaknesses of disaster management approaches.		

UNIT I - INTRODUCTION	**(6)**
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	
UNIT II – REPERCUSSIONS OF DISASTERS AND HAZARDS	**(6)**
Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	
UNIT III – DISASTER PRONE AREAS IN INDIA	**(6)**
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.	
UNIT IV – DISASTER PREPAREDNESS AND MANAGEMENT	**(6)**
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.	

UNIT V – RISK ASSESSMENT	(6)
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	
TOTAL (L:30) : 30 PERIODS	

REFERENCES :

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

22PGA03 - CONSTITUTION OF INDIA					
		L	T	P	C
		2	0	0	0
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	**1.1**	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.		
2.0	To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional	**2.1**	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.		
3.0	To role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.	**3.1**	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution..		
4.0	To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution	**4.1**	Discuss the passage of the Hindu Code Bill of 1956.		
5.0	To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	**5.1**	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.		

UNIT I - HISTORY OF MAKING OF THE INDIAN CONSTITUTION	**(6)**
History, Drafting Committee, (Composition & Working)	
UNIT II – PHILOSOPHY OF THE INDIAN CONSTITUTION	**(6)**
Preamble, Salient Features	
UNIT III – ONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	**(6)**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	

UNIT IV – LOCAL ADMINISTRATION	(6)
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayat raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	
UNIT V – ELECTION COMMISSION	**(6)**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	
	TOTAL (L:30) : 30 PERIODS

REFERENCES :

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.