BACHELOR OF TECHNOLOGY IN

COMPUTER SCIENCE AND ENGINEERING

(As per National Education Policy 2020)

Scheme & Syllabus



G H RAISONI COLLEGE OF ENGINEERING AND MANAGEMENT

Department of Computer Science and Engineering

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-I													
23BTSHL102CS 23BTSHP102CS	Environmental Chemistry	BSC5	1	-	2	3	2	10	15	50	25	-	100
23BTSHL103CS	Matrices and Differential Calculus	BSC1	2	1	-	3	3	10	15	50	-	-	75
23BTSHL105CS	Linear Algebra and Statistics	BSC4	2	1	-	3	3	10	15	50	-	-	75
23BTSHP112CS	Liberal Learning Courses-I	CC1	-	-	4	4	2	-	-	-	25	25	50
23BTEEL101CS 23BTEEP101CS	Basic Electrical Engineering	ESC1	3	-	2	5	4	10	15	50	25	-	100
23BTECL101CS 23BTECP101CS	Digital Logic Design	ESC2	3	-	2	5	4	10	15	50	25	-	100
23BTCSL10X 23BTCSP10X	Elective -I : Vocational and Skill Enhancement	VSEC1	1	-	2	3	2	10	15		25	-	50
TOTAL			**12**	**2**	**12**	**26**	**20**	**60**	**90**	**250**	**125**	**25**	**550**

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-II													
23BTSHL101CS 23BTSHP101CS	Engineering Physics	BSC2	1	1	2	4	3	10	15	50	25	-	100
23BTSHL104CS	Integral Calculus And Differential Equations	BSC3	2	1	-	3	3	10	15	50	-	-	75
23BTSHL108CS 23BTSHP108CS	Communicatio n Skills	AEC1	1	-	2	3	2	10	15		25	-	50
23BTSHL10XCS	Elective : Indian Knowledge System	IKS	2	-	-	2	2	10	15	50			75
23BTSHP113CS	Liberal Learning Courses-II	CC2	-	-	4	4	2	-	-	-	25	25	50
23BTITL102CS 23BTITP102CS	Programming for Problem Solving	ESC3	3	-	2	5	4	10	15	50	25	-	100
23BTCSL101 23BTCSP101	Computer Fundamentals and Trouble Shooting	PCC1	1	-	2	3	2	10	15	50	25	-	100
23BTCSL10X 23BTCSP10X	Elective –II: Vocational and Skill Enhancement	VSEC2	1	-	2	3	2	10	15		25	-	50
TOTAL			**11**	**2**	**14**	**27**	**20**	**70**	**105**	**250**	**150**	**25**	**600**

Department of Computer Science and Engineering

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-III													
23BTSHL201CS	Discrete Mathematics and Graph Theory	PCC2	3	1		4	4	10	15	50			75
23BTCSL201/ 23BTCSP201	Data Structure and Algorithms	PCC3	3		2	5	4	10	15	50	25	25	125
23BTCSL202	Multi-Disciplinary Minor-I(Computer Architecture)	MD M1	2			2	2	10	15	50			75
23BTCSL211	Open elective –I: Introduction To Blockchain Technology	OE1	4			4	4	10	15	50			75
23BTMBL201CS	Engineering Economics and Industrial Management	EEMC1	2			2	2	10	15	50			75
23BTSHL228 23BTSHL229 23BTSHL227	Humanities Elective: 1)Content Designing and Media fundamentals 2)Cyber ethics and Moral responsibilities 3)Applied life Skills for progressive excellence	VEC1	2			2	2	10	15	50			75
23BTCSP205	Minor Project	CEP			4	4	2				25	25	50
TOTAL			**16**	**1**	**6**	**23**	**20**	**60**	**90**	**300**	**50**	**50**	**550**

Department of Computer Science and Engineering

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-IV													
23BTCSL203	Computer Architecture and Organization	PCC8	4			4	4	10	15	50			75
23BTCSL204/ 23BTCSP204	Database Management System	PCC5	3		2	5	4	10	15	50	25	25	125
23BTCSL206	Multi-Disciplinary Minor:(Web Development)	MD M2	2			2	2	10	15	50			75
23BTCSL221	Open elective –II	OE2	2			2	2	10	15	50			75
23BTCSL207/ 23BTCSP207/	Vocational and Skill Enhancement Elective – III((POOP) PRINCIPLES OF OBJECT ORIENTED PROGRAMMING	VSEC3	1		2	3	2	10	15		25		50
23BTSHL231CS/23BTSHP231CS	Aptitude & Employability Skills	AEC2	1		2	3	2	10	15		25		50
23BTMBL202CS	Entrepreneurship Development Practices	EEMC2	2	-	-	2	2	10	15	50	-	-	75
23BTSHL233CS	Universal Human Values 2 : Understanding Harmony	VEC2	2			2	2	10	15	50			75
TOTAL			**17**	**-**	**6**	**23**	**20**	**80**	**120**	**300**	**75**	**25**	**600**

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Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-V													
23BTCSL301	Formal Languages and Automata	PCC7	3			3	3	10	15	50			75
23BTCSL304/ 23BTCSP304	Operating System	PCC8	3		2	5	4	10	15	50	25	25	125
23BTITL301CS/ 23BTITP301CS	Computer Networks	PCC9	2		2	4	3	10	15	50	25		100
23BTCSL311 23BTCSL312 23BTCSL313 23BTCSL314	Programme Elective Core1 1)Cloud computing 2)UNSTRUCTURD DATABASE MANAGEMENT 3)Natural Language Processing 4)Code Repository and Version Control	PEC1	3		2	5	4	10	15	50	25		100
23BTCSL305 23BTCSL310	Multi-Disciplinary Minor:III (data structure with C programming/ Backend Programming)	MDM3	3		2	5	4	10	15	50	25		100
23BTCSL306	Open elective - III(Relational databases)	OE3	2			2	2	10	15	50			75
23BTSHP301CS	Research Methodology	RM			4	4	2				25		25
TOTAL			**16**		**12**	**28**	**22**	**60**	**90**	**300**	**125**	**25**	**600**

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Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VI													
23BTCSL303/ 23BTCSP303	Design and Analysis of Algorithms	PCC9	3		2	5	4	10	15	50	25	25	125
23BTCSL307	Data Mining and Warehousing	PCC12	3		2	5	4	10	15	50	25	25	125
23BTCSL321 23BTCSL322 23BTCSL323 23BTCSL324	Programme Elective Core2 1)Salesforce 2)Big Data Computing 3) User InterfaceDesign 4) Blockchain Technology	PEC2	3		2	5	4	10	15	50	25		100
23BTCSL331 23BTCSL332 23BTCSL333	Programme Elective Core3 1)Agile Scrum Master 2)Mobile Computing 3)Distributed Computing	PEC3	4			4	4	10	15	50			75
23BTCSL308	Multi-Disciplinary Minor-IV(Introduction to Cloud Computing)	MDM4	2			2	2	10	15	50			75
23BTCSL309	Vocational andSkill Enhancement Elective – IV(Web Technology)	VSEC4	1		2	3	2	10	15		25	-	50
23BTSHP302	Research Methodology	RM			4	4	2				50		50
TOTAL			**16**		**12**	**28**	**22**	**60**	**90**	**250**	**150**	**50**	**600**

Department of Computer Science and Engineering

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VII													
23BTCSL401/ 23BTCSP401	Compiler Design	PCC11	3		2	5	4	10	15	50	25	25	125
23BTCSL402	Artificial Intelligence and Machine Learning	PCC4	3			3	3	10	15	50			75
23BTCSL403	Computer System Security	PCC13	3			3	3	10	15	50			75
23BTCSL441 23BTCSL442 23BTCSL443	Programme Elective Core4 1)Parallel computing 2)Digital forensics 3)Optimization techniques	PEC4	4			4	4	10	15	50			75
23BTCSL405	Multi-Disciplinary Minor-V(Python Programming)	MDM5	4			4	4	10	15	50		-	75
23BTCSL404	Project	P			8	8	4				50	50	100
TOTAL			**17**		**10**	**27**	**22**	**50**	**75**	**250**	**75**	**75**	**525**

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VIII													
23BTCSL406	Programme Elective Core5(Mooc's Based)	PEC5	4			4	4	10	15	50			75
23BTCSP407	Internship	I			24	24	12				200	100	300
TOTAL			**4**		**24**	**28**	**16**	**10**	**15**	**50**	**200**	**100**	**375**

Department of Computer Science and Engineering

Multidisciplinary Minor from Other Department

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-III													
23BTECL206CS	Fundamentals of Electronic Devices	MDM1	2	-	-	2	**2**	10	15	50	-	-	75
SEMESTER-IV													
23BTITL204CS	Software Engineering and Project Management	MDM2	2	-	-	2	**2**	10	15	50	-	-	75
SEMESTER-V													
		MDM3	3	-	2	5	**4**	10	15	50	25	-	100
SEMESTER-VI													
		MDM4	2	-	-	2	**2**	10	15	50	-	-	75
SEMESTER-VII													
		MDM5	4	-	-	4	**4**	10	15	50	-	-	75
TOTAL			**13**	**-**	**2**	**15**	**14**	**50**	**75**	**250**	**25**	**-**	**400**

UG Scheme-2023 (NEP-2020)
B. Tech. in Computer Science & Engineering
Vocational & Skill Enhancement Courses (VSEC)

Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-I													
23BTCSL102/ 23BTCSP102	Computer Programming	VSEC1	1	-	2	3	2	10	15	-	25	-	50
SEMESTER-II													
23BTCSL105/ 23BTCSP105	Foundation of Data Analytics	VSEC2	1	-	2	3	2	10	15	-	25	-	50
SEMESTER-IV													
23BTCSL207/ 23BTCSP207	Principles of Object Oriented Programming	VSEC3	1	-	2	3	2	10	15	-	25	-	50
SEMESTER-VI													
23BTCSL309/ 23BTCSL309	Web Technology	VSEC4	1	-	2	3	2	10	15	-	25	-	50
TOTAL			**4**	**-**	**8**	**12**	**8**	**40**	**60**	**-**	**100**	**-**	**200**

Minor Track: Computer Science & Engineering

Semester	Credits [TH + PR]	Code-Course	Course Name
III	4	23BTCSL201/ 23BTCSP201	Data Structure and Algorithms
IV	4	23BTCSL204/ 23BTCSP204	Database Management Systems
	4	23BTCSL203	Computer Architecture and Organization
V	4	23BTCSL304/ 23BTCSP304	Operating System
	3	23BTCSL301	Formal Languages and Automata
VI	4	23BTCSL303/ 23BTCSP303	Design and Analysis of Algorithms
	4	23BTCSL307	Data Mining and Warehousing
VII	4	23BTCSL401/ 23BTCSP401	Compiler Design
VIII	-	-	-

Honor Track: Computer Science & Engineering

Semester	Credits [TH + PR]	Code-Course	Course Name
III	4	PNCSEL546	Distributed Operating System
IV	4	PNCSEL563	HIGH PERFORMANCE COMPUTER ARCHITECTURE
	3	PNCSEL588	Elective-III: DATA SCIENCE
V	3	PNCSEL551	Elective-I: Soft computing
	4+1	PNCSEL547/ PNCSEP547	Advances in Algorithm
VI	4	PNCSEL556	Big Data Computing
	3	PNCSEL576	Elective-IV: OPTIMIZATION TECHNIQUES
VII	3	PNCSEL558	Elective-II: HUMAN COMPUTER INTERACTION
VIII	-	-	-

Computer Science and Engineering

Courses offeredin Multidisciplinary Track

Semester	Credits [TH + PR]	Code-Course	Course Name
III	2	23BTCSL202	Computer Architecture
IV	2	UNCSL206	Software Testing
V	4 [3 TH + 1 PR]	UNCSL307/ UNCSP307	Data Structure using C
	4 [3 TH + 1 PR]	UNCSL308/ UNCSP308	Introduction to Database
VI	2	UNCSL309	Basics of Scripting Language
	2	UNCSL320	Introduction to Cloud Computing
VII	4	UNCSL319	Distributed Computing
	4	UNCSL317	Agile Scrum Master
VIII	-	-	-

Department of Computer Science and Engineering

Course Title: **Data Structure and Algorithms**										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	3	--	2	4	10	15	50	25	25
Course Code	23BTCSL201/ 23BTCSP201									
Teaching Mode	Online	5			Total	75			50	
Duration of ESE						125				

Course Objectives	This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
	It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.
	The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.
Course Outcomes	CO1: Analyze various techniques for searching, Sorting and Hashing.
	CO2: Illustrate linear arrays and linked lists, including operations such as insertion, deletion, traversal, sorting, and searching.
	CO3: Demonstrate the array and linked representations of stacks and queues and their applications.
	CO4: Apply trees as non-linear data structure to find solution for given engineering applications.
	CO5: Understand the basics of Graphs as non-linear data structures.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		3	2	3									1	
CO2		2	3	3									2	
CO3		3	3	3									2	1
CO4		3	3	3									3	2
CO5		3	3	2									3	1

Course Contents:

Unit	Contents	Hours
I	Introduction to Algorithms, Searching and Sorting Introduction to Algorithms, Common operations on data structures, Types of data structures, Abstract Data Type Time and Space Complexity, Step Count Method, Asymptotic Notations. Searching: Linear Search, Binary Search Sorting: Bubble sort, Selection Sort, Merge-Sort, Shell Sort, Radix Sort, Introduction to Hashing	9
II	Arrays and Linked Lists Arrays: Introduction, Linear Arrays, Arrays as ADT, Representation of Linear array in Memory, Traversing Linear Arrays, Insertion and deletion in arrays. Linked List: Introduction, Representation of Linked Lists in Memory, Traversing a Linked List, Searching a Linked List, Memory Allocation; Garbage Collection, Types of linked lists, Insertion and Deletion in Singly Linked List, Insertion and Deletion in Doubly Linked List, Insertion and Deletion in Circular Linked List	9
III	Stacks, Queue and Recursion Stacks-Introduction to Stacks ,Array Representation of Stacks ,Linked Representation of Stacks, Stack as ADT, Various operations on stacks using arrays and linked lists, Application of Stacks : Polish Notations, Recursion, Towers of Hanoi Queue: Introduction to Queues, Array Representation of Queues, Linked Representation of Queues, Queues as ADT, Circular Queues, Deques, Priority Queues, Applications of Queues	9
IV	Trees and Binary Trees General and Binary Trees, Representation of binary tree in memory, Operations on Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Binary Search Trees ,various operations in Binary Search Trees, AVL Search Trees, Insertion in an AVL Search Tree, Deletion in an AVL Search Tree, m-way Search Trees, B-Trees-Insertion and deletion in B-Tree, B+Trees-Insertion and deletion in B+Tree	10
V	Graphs and their Applications: Introduction, Graph Theory Terminology, Representation of Graphs, Operations on Graphs, Traversing a Graph, Posets , Topological Sorting, Spanning Trees, Minimum Spanning Trees	8

Text Books	1.	AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison-Wesley, 1983.
	2.	THCormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.
	3.	Sahni, S., "Data Structures, Algorithms, and Applications in C++", WCB/McGraw-Hill.

E--Books	1.	https://apps2.mdp.ac.id/perpustakaan/ebook/Karya%20Umum/Dsa.pdf
Reference Books	1.	Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.
	2.	MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithms in Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)
	3.	Wirth, N., "Algorithms and Data Structures", Prentice-Hall of India.
On-line TL Material	1.	https://nptel.ac.in/courses/106/102/106102064/
	2.	http://cse01-iiith.vlabs.ac.in/
	3.	https://ds2-iiith.vlabs.ac.in/data-structures-2/

Department of Computer Science and Engineering

Course Title: Introduction to Blockchain Technology open elective -I										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	4		-	4	10	15	50	-	
Course Code	23BTCSL211									

Course Objectives	The student should be made to:
	1. Understand the technical aspects of crypto currencies and block chain technologies.
	2. Understand fundamental concepts of the cryptographic concepts
	3. Understand fundamental concepts of the cryptocurrencies.
	4. Understand the concepts of cryptocurrency regulations.
Course Outcomes	At the end of the course, the student should be able to
	CO1: Describe the basic concepts and technology used for blockchain.
	CO2: Analyse the primitives of the distributed computing and cryptography related to blockchain.
	CO3: Illustrate the concepts of Bitcoin and their usage.
	CO4: Implement Ethereum block chain contract.
	CO5: Apply security features in blockchain technologies.

Ma Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	2	1	3	1
CO2	2	3	-	3	1	-	-	-	-	-	-	3	1	3	2
CO3	3	-	-	2	1	-	-	-	-	-	-	2	1	3	1
CO4	2	3	-	2	1	-	-	-	-	-	-	3	1	1	2
CO5	3	-	-	2	-	-	-	-	-	-	-	2	1	1	3

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Need for Distributed Record Keeping, Byzantine Generals problem, Why Nakamoto Came up with Blockchain based cryptocurrency? , Consensus, Consensus Algorithm, Peer to peer network , byzantine fault-tolerant distributed computing, Byzantine Models of fault tolerance .	7
II	**Cryptographic Fundamentals:** Cryptographic basics for crypto currency - a short overview of Hashing, cryptographic algorithm – SHA 256,signature schemes, encryption schemes and elliptic curve cryptography- Introduction to Hyperledger- Hyperledger framework - Public and Private Ledgers.	8
III	**Bitcoin** Bitcoin –Wallet-Block, Merkle tree, Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their uses.	6
IV	**Ethereum** Ethereum_ Ethereum Virtual Machine (EVM) - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin, comparing Bitcoin scripting vs. Ethereum Smart Contracts	8
V	**Cryptocurrency Regulation :**Stakeholders, Roots of Bit coin, Legal Aspects- Crypto currency Exchange, Black Market and Global Economy. **Privacy, Security issues in Blockchain** :seudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining	8

Text Books	1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
	2.	Anshul Kaushik, "Block Chain and Crypto Currencies", Khanna Publishing House, Delhi
Reference Books	1.	Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
	2.	Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
	3.	DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow Paper 2014
	4	Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum ,smart contracts

	5	Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.
On-line TL Material	1.	Prof. Sandeep Shukla, IIT Kanpur https://nptel.ac.in/courses/106/104/106104220/
	2.	Prof. Praveen Jayachandran, IIT Kharagpur https://nptel.ac.in/courses/106/105/106105184/

Department of Computer Science and Engineering

Title: **Computer Architecture and Organization**										
Semester	III	Course Title: Computer Architecture and Organization								
Term	Odd	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Course Category	PCC8	Th	Tu	Pr	Credits	TAE	CAE	ESE	Int	Ext
Course Code	23BTCSL203	4	-	-	4	10	15	50	-	-
Teaching Mode	Offline									

Course Objectives	To understand the design principles of digital computing systems
	To provide an essential understanding of different subsystems of modern computer system and design aspects of these subsystems3
	To provide an overview of performance enhancement methods in instruction Execution
Course Outcomes	CO1: To describe the basic components and design of a computer system
	CO2: To examine the issues involved in the instruction execution and various stages of instruction life stage
	CO3: To apply the concept of various memories and interfacing technologies
	CO4: To analyze the different parallel processing technique
	CO5: To design different high-performance computing architecture

Mapping of Course Outcomes with Program Outcomes and Program-Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											2		
CO3		3											2		
CO4			3										3		
CO5			3											3	

Course Contents:

Unit	Contents	Hours
I	Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU –registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set, Instruction set architecture CISC, RISC, Case study: Instruction sets of common CPUs	8
II	Data representation method, IEEE standard: single and double precision format and examples, Fixed point Addition, Subtraction, Multiplication, and Division. Floating Point Arithmetic, High-performance arithmetic. Booth's algorithm: Multiplication & Division	8
III	Memory hierarchy, Memory Chip Organization, Cache memory, and Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, DMA, Serial Bus Architectures, Mass storage, Input and Output Devices, Segmentation, TLB	8
IV	An Overview of Pipelining: Basic concepts of Pipelining, Pipelined Datapath, and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Arithmetic and Instruction Pipeline, throughput and speedup, pipeline hazards.	8
V	CPU control unit design: hardwired and micro-programmed design approaches, Case study: Von Neumann Architecture, Design of a simple hypothetical CPU, Multicore processors architecture, Simple MIPS Processor Components, Designing a Datapath for a Simple Processor	8

Text Books	1.	Computer Organization and Architecture by Carl Hamacher 4th Edition
	2.	Advance computer Architecture by Kai Hwang under Tata McGraw Hill Publications
	3.	Introduction to Parallel Processing: Algorithms & Architectures, Behrooz Parhami in Springer Shop
EBooks	1.	Computer Architecture and Organization by William Stalling http://home.ustc.edu.cn/~leedsong/reference_books_tools/Computer%20Organization%20and%20Architecture%2010th%20-%20William%20Stallings.pdf
Reference Books	1.	Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare By PHI Publications
	2.	Fundamentals of Parallel Processing by Jordan Harry, Alaghband Gita, PHI Publication
	3	Parallel Computers – Architecture and Programming by V. Rajaraman And C. Siva Ram Murthy.
	4.	Introduction to Parallel Programming by Steven Brawer
On-line TL Material	1.	NPTL https://nptel.ac.in/courses/106/105/106105163/

Department of Computer Science and Engineering

Course Title: Computer Architecture MD-I										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Core	2 Hrs.	- -	--	2	10	15	50	--	--
Course Code	23BTCSL208									
Teaching Mode	Offline	2 Hrs			Total	75			-	
Duration of ESE	2 Hrs.					75				

Course Objectives	To understand the design principles of digital computing systems
	To provide essential understanding of different subsystems of modern computer system and design aspects these subsystems3
	To provide overview on performance enhancement methods in instruction execution
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: To describe the basic components and design of a computer system
	CO2: To examine the issues involved in the instruction execution and various stages of instruction life stage
	CO3: To apply the concept of various memories and interfacing technologies
	CO4: To analyze the different parallel processing technique
	CO5: To design different high performance computing architecture

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO0	PO1	PO2	PSO1	PSO2
CO1	1	--	--	--	--	--	--	--	--	--	--	--	3	--
CO2	--	2	--	--	--	--	--	--	--	--	--	--	2	--
CO3	--	3	--	--	--	--	--	--	--	--	--	--	2	--
CO4	--	--	3	--	--	--	--	--	--	--	--	--	3	--
CO5	--	--	3	--	--	--	--	--	--	--	--	--	--	3

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Overview and history of computer architecture, CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU:–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, Instruction set architecture CISC, RISC. **Case study:** –instruction sets of common CPUs, performance matrices for calculation of processing in Computer	5
II	**Computer Arithmetic:** Fixed point Addition, Subtraction, Multiplication and Division. Floating Point Arithmetic, High-performance arithmetic, Booth's algorithm: Division and Multiplication, Data representation methods. **IEEE standard:** single and double precision format and examples, ALU	5
III	**Memory Architecture:** Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory, Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices, Segmentation, TLB, DMA	5
IV	**An Overview of Pipelining:** Basic concepts of Pipelining, Pipelined Datapath, and Control. **Data Hazards:** Forwarding versus Stalling, Control Hazards, Exceptions, Arithmetic and Instruction Pipeline, throughput and speedup, pipeline hazards.	5
V	**Processor Architecture:** hardwired and micro-programmed design approaches, Case study - design of a simple hypothetical CPU. Multicore processors architecture, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers, Advanced topics & its application.	5

Text Books	1.	Computer Organization and Architecture by Carl Hamacher 4th Edition
	2.	Advance computer Architecture by Kai Hwang under Tata McGraw Hill Publications
	3.	Introduction to Parallel Processing: Algorithms & Architectures, Behrooz Parhami in Springer Shop
EBooks	1.	Computer Architecture and Organization by William Stalling http://home.ustc.edu.cn/~leedsong/reference_books_tools/Computer%20Organization%20and%20Architecture%2010th%20-%20William%20Stallings.pdf
Reference Books	1.	Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare By PHI Publications
	2.	Fundamentals of Parallel Processing by Jordan Harry, Alaghband Gita, PHI Publication
	3	Parallel Computers – Architecture and Programming by V. Rajaraman And C. Siva Ram Murthy.
	4.	Introduction to Parallel Programming by Steven Brawer
On-line TL Material	1.	NPTL https://nptel.ac.in/courses/106/105/106105163/

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Course Title: Introduction to Blockchain Technology										
Semester	III	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	4		-	4	10	15	50	-	
Course Code	23BTCSL211									

Course Objectives	The student should be made to:
	1. Understand the technical aspects of crypto currencies and block chain technologies.
	2. Understand fundamental concepts of the cryptographic concepts
	3. Understand fundamental concepts of the cryptocurrencies.
	4. Understand the concepts of cryptocurrency regulations.
Course Outcomes	At the end of the course, the student should be able to
	CO1: Describe the basic concepts and technology used for blockchain.
	CO2: Analyse the primitives of the distributed computing and cryptography related to blockchain.
	CO3: Illustrate the concepts of Bitcoin and their usage.
	CO4: Implement Ethereum block chain contract.
	CO5: Apply security features in blockchain technologies.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	-	-	-	-	-	-	2	1	3	1
CO2	2	3	-	3	1	-	-	-	-	-	-	3	1	3	2
CO3	3	-	-	2	1	-	-	-	-	-	-	2	1	3	1
CO4	2	3	-	2	1	-	-	-	-	-	-	3	1	1	2
CO5	3	-	-	2	-	-	-	-	-	-	-	2	1	1	3

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Need for Distributed Record Keeping, Byzantine Generals problem, Why Nakamoto Came up with Blockchain based cryptocurrency? , Consensus, Consensus Algorithm, Peer to peer network , byzantine fault-tolerant distributed computing, Byzantine Models of fault tolerance .	7
II	**Cryptographic Fundamentals:** Cryptographic basics for crypto currency - a short overview of Hashing, cryptographic algorithm – SHA 256,signature schemes, encryption schemes and elliptic curve cryptography- Introduction to Hyperledger- Hyperledger framework - Public and Private Ledgers.	8
III	**Bitcoin** Bitcoin –Wallet-Block, Merkle tree, Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their uses.	6
IV	**Ethereum** Ethereum_ Ethereum Virtual Machine (EVM) - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin, comparing Bitcoin scripting vs. Ethereum Smart Contracts	8
V	**Cryptocurrency Regulation :** Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. **Privacy, Security issues in Blockchain** : seudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining	8

Text Books	1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
	2.	Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi
Reference Books On-line TL Material	1.	Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
	2.	Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
	3.	DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellow Paper 2014
	4	Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum ,smart contracts

	5	Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.
On-line TL Material	1.	Prof. Sandeep Shukla, IIT Kanpur https://nptel.ac.in/courses/106/104/106104220/
	2.	Prof. Praveen Jayachandran, IIT Kharagpur https://nptel.ac.in/courses/106/105/106105184/

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Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-IV													
23BTCSL203	Computer Architecture and Organization	PCC8	4			4	4	10	15	50			75
23BTCSL202/ 23BTCSP202	Database Management Systems	PCC5	3		2	5	4	10	15	50	25	25	125
UNXXL2XX	Multi-Disciplinary Minor:	MD M2	2			2	2	10	15	50			75
23BTCSL221	Open elective -II	OE2	2			2	2	10	15	50			75
UNXXL2XX / UNXXP2XX	Vocational and Skill Enhancement Elective -III	VSEC3	1		2	3	2	10	15		25		50
UNHUL202/ UNHUP202	Aptitude & Employability Skills	AEC2	1		2	3	2	10	15		25		50
UNHUL203	Entrepreneurship Development Practices	EEMC2	2	-	-	2	2	10	15	50	-	-	75
UNHUL204	Universal Human Values 2 : Understanding Harmony	VEC2	2			2	2	10	15	50			75
TOTAL			**17**	**-**	**6**	**23**	**20**	**80**	**120**	**300**	**75**	**25**	**600**

Title: **Computer Architecture and Organization**										
Semester	IV	Course Title: Computer Architecture and Organization								
Term	OddEven	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Course Category	PCC8	Th	Tu	Pr	Credits	TAE	CAE	ESE	Int	Ext
Course Code	23BTCSL203	4	-	-	4	10	15	50	-	-
Teaching Mode	Offline									

Course Objectives	To understand the design principles of digital computing systems
	To provide an essential understanding of different subsystems of modern computer system and design aspects of these subsystems3
	To provide an overview of performance enhancement methods in instruction Execution
Course Outcomes	CO1: To describe the basic components and design of a computer system
	CO2: To examine the issues involved in the instruction execution and various stages of instruction life stage
	CO3: To apply the concept of various memories and interfacing technologies
	CO4: To analyze the different parallel processing technique
	CO5: To design different high-performance computing architecture

Mapping of Course Outcomes with Program Outcomes and Program-Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3											2		
CO3		3											2		
CO4			3										3		
CO5			3											3	

Course Contents:

Unit	Contents	Hours
I	Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU –registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set, Instruction set architecture CISC, RISC, Case study: Instruction sets of common CPUs	8
II	Data representation method, IEEE standard: single and double precision format and examples, Fixed point Addition, Subtraction, Multiplication, and Division. Floating Point Arithmetic, High-performance arithmetic. Booth's algorithm: Multiplication & Division	8
III	Memory hierarchy, Memory Chip Organization, Cache memory, and Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, DMA, Serial Bus Architectures, Mass storage, Input and Output Devices, Segmentation, TLB	8
IV	An Overview of Pipelining: Basic concepts of Pipelining, Pipelined Datapath, and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Arithmetic and Instruction Pipeline, throughput and speedup, pipeline hazards.	8
V	CPU control unit design: hardwired and micro-programmed design approaches, Case study: Von Neumann Architecture, Design of a simple hypothetical CPU, Multicore processors architecture, Simple MIPS Processor Components, Designing a Datapath for a Simple Processor	8

Text Books	1.	Computer Organization and Architecture by Carl Hamacher 4th Edition
	2.	Advance computer Architecture by Kai Hwang under Tata McGraw Hill Publications
	3.	Introduction to Parallel Processing: Algorithms & Architectures, Behrooz Parhami in Springer Shop
EBook s	1.	Computer Architecture and Organization by William Stalling http://home.ustc.edu.cn/~leedsong/reference_books_tools/Computer%20Org anization%20and%20Architecture%2010th%20-%20William%20Stallings.pdf
Refere nce Books	1.	Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare By PHI Publications
	2.	Fundamentals of Parallel Processing by Jordan Harry, Alaghband Gita, PHI Publication
	3	Parallel Computers – Architecture and Programming by V. Rajaraman And C. Siva Ram Murthy.
	4.	Introduction to Parallel Programming by Steven Brawer
On- line TL Materi al	1.	NPTL https://nptel.ac.in/courses/106/105/106105163/

Department of Computer Science and Engineering

Course Title: **DATABASE MANAGEMENT SYSTEM**										
Semester	IV	Teaching Scheme				Evaluation cheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC5	2 Hrs.	1 Hr.	2	4	10	15	50	25	25
Course Code	23BTCSL202									
Teaching Mode	Offline	3 Hrs			Total	75			50	
Duration of ESE	2 Hrs					12 55				

Course Objectives	This course introduces general idea of database management system, also gives idea to design databases using data modeling and design techniques.
	It is also aimed to developing skills to implement real life applications which involve database handling.
	This course also provide carrier opportunities in subject areas of designing, storage techniques and data handling and managing techniques
Course Outcomes	**CO1**: Analyze an information storage problem and derived an information model expression in the form of Entity relation diagramand design appropriate data model for it.
	CO2: Demonstrate SQL queries to perform CRUD (Create, Retrieve,Update, Delete) operations on database and perform inferential analysis of data model
	CO3: Identify features of database management systems and Relational database and Understand functional dependencies and various normalization forms
	CO4: Perform basic transaction processing and m nagement and ensure database security, integrity and concurrency control
	CO5: Analyze the management of structured and unstructured data management with recent tools and technologies

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	--	--	3	--	3	--	--	--	--	--	--	--	2	--
CO2	--	--	3	3	--	--	--	--	--	--	--	--	3	--
CO3	--	2	3	--	--	--	--	--	--	--	--	--	--	3
CO4	--	--	3	2	--	--	--	--	--	--	--	--	2	--
CO5	--	--	2	--	3	--	--	--	--	--	--	--	2	--

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Unit	Contents	Hours
I	Introduction to DBMS - DBMS Architecture, Data Models, E-R Diagram, Relational Database design:	6
II	SQL Concepts - Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types.	8
III	Functional Dependency (FD) – Basic concepts, closure of set of FD, closure of attribute set, Decomposition, Normalization – 1NF, 2NF, 3NF, BCNF, 4NF	5
IV	Transaction control commands – Commit, Rollback, Save point. Transaction Management: Transaction concepts, properties of transactions, serializability of transactions, Two- Phase Commit protocol, Deadlock, two-phase locking protocol. Cursors, Stored Procedures, Stored Function, Database Trigger, Database recovery.	7
V	Indexing and hashing, Query processing, Query Optimization, Data Mining, Advances in databases	4

Text Books	1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002.
	2.	Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.
E-Books	1.	https://ebooks.lpude.in/computer_application/mca/term_1/DCAP204_MANAGING_DATABASE_DCAP402_DATABASE_MANAGEMENT_SYSTEMS.pdf
Reference Books	1.	G. K. Gupta :"Database Management Systems", McGraw – Hill.
	2.	Regina Obe, Leo Hsu, PostgreSQL: Up and Running, 3rd Ed, O'Reilly Media 2017.
	3.	Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O'Reilly Media 2018.
	4.	RamezElmasri and ShamkantNavathe, Fundamentals of Database Systems 2nd Ed, Benjamin Cummings, 1994.
online TL Material	1.	https://nptel.ac.in/courses/106/105/106105175/

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Course Title: **Multidisciplinary Minor II:Data Structure Using C**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MD M2	2	--		2	10	15	50		
Course Code	23BTCSL204									
Teaching Mode	Offline	2			Total	75				
Duration of ESE						75				

Course Objectives	This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
	It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.
	The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.
Course Outcomes	CO1: choose appropriate data structure as applied to specified problem Definition Analyze various techniques for searching, Sorting and Hashing.
	CO2: Illustrate linear arrays and linked lists, including operations such as insertion, deletion, traversal, sorting, and searching.
	CO3: to apply concepts Analyze various techniques for searching, Sorting and Hashing
	CO4: to use linear and non-linear data structures like stacks, queues, linked list..
	CO5: Understand the basics of Graphs as non-linear data structures.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		3	2	3									1	
CO2		2	3	3									2	
CO3		3	3	3									2	1
CO4		3	3	3									3	2
CO5		3	3	2									3	1

Course Contents:

Unit	Contents	Hours
I	Enumerated, Structure ,and Union Types– The Type Definition (typedef), Enumerated types, Structures –Declaration, initialization, accessing structures, operations on structures, Complex structures, structures and functions, Passing structures through pointers, self referential structures, unions, bit fields, C programming examples	6
II	Data Structures – Introduction to Data Structures, abstract data types. Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, circularly linked lists- Operations for Circularly linked lists, doubly linked list implementation, insertion, deletion and searching operations, applications of linked lists.	6
III	Stack ADT- definition, operations, array and linked implementations in C, applications- infix to postfix conversion, Postfix expression evaluation, recursion implementation. Queue ADT- definition and operations, array and linked Implementations in C, Circular queues Insertion and deletion operations	6
IV	Searching and Sorting – Searching-linear and binary search methods Sorting- selection sort, bubble sort, insertion sort, quick sort, merge sort comparison of sorting and searching methods.	6
V	Trees – Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, applications of trees.	6

Text Books	1.	AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison-Wesley, 1983.
	2.	THCormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.
	3.	Sahni, S., "Data Structures, Algorithms, and Applications in C++", WCB/McGraw-Hill.
	4.	Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan AndersonFreed, Universities Press.
E--Books	1.	https://apps2.mdp.ac.id/perpustakaan/ebook/Karya%20Umum/Dsa.pdf
Reference Books	1.	Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.
	2.	Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung,Pearson
	3.	MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithms in Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)
	3.	Wirth, N., "Algorithms and Data Structures", Prentice-Hall of India.
On-line TL Material	1.	https://nptel.ac.in/courses/106/102/106102064/
	2.	http://cse01-iiith.vlabs.ac.in/
	3.	https://ds2-iiith.vlabs.ac.in/data-structures-2/

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Course Title: **Vocational & Skill Enhancement Elective-III: Principals of Object Oriented Programming**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C	1 Hrs.	-	2 Hrs.	2	10	15		25	-
Course Code	23BTCSL205									
Teaching Mode	Offline	3 Hrs.			TOTAL	25			25	
Duration of ESE	NA					50				

Course Objectives	1. This course introduces student's general idea and concepts of object-oriented programming.
	2. It is also aimed at developing skills to implement these concepts.
	3. The course provide carrier opportunities in design of some applications as object-oriented concepts plays dominant role in software development
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Articulate the principles of object-oriented programming.
	CO2: Develop the basics of C++ programming.
	CO3: Implement the object oriented programming in terms of classes and objects.
	CO4: Implement constructors, destructors and operator overloading for software Development.
	CO5: Apply Inheritance and Polymorphism for generic programming applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO1	--	3	--	--	--	--	--	--	--	--	--	--	2	--	--
CO2	--	--	3	--	--	--	--	--	--	--	--	--	3	--	--
CO3	--	--	2	2	--	--	--	--	--	--	--	--	3	--	--
CO4	--	--		2	--	--	--	--	--	--	--	--	2	--	--
CO5	--	--		2	--	--	--	--	--	--	--	--	2	--	--

Course Contents:

Unit	Contents	Hours
I	**Principles Of Object-Oriented Programming:** Principles of Object Oriented Programming (OOP), Software Evaluation, A Look at Procedure Oriented Programming, OOP Paradigm, Basic Concepts of OOP, Benefits of OPP, Application of OOP.	5
II	**Introduction to C++** What is C++, A simple C++ Program, More C++ statements, Structure of C++ Program., Tokens , Keywords, Identifiers and Constants, C++ data types, Variables: Declaration, Dynamic initialization of variables, Reference variables, Operators in C++ : Scope resolution operator, Member deferencing Operators, Memory Management Operators, Manipulators, Type cast operators, Expressions and Control Structures.	5
III	**Classes and Objects:** Introduction, Specifying a Class, Defining member Functions, C++ Program with Class, Nesting of Member functions, Private member functions, Memory Allocation for Objects, Static Data members, Static Member Functions, Arrays within a Class, Arrays of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects.	5
IV	**Constructors, Destructors and operator Overloading:** Constructors, Parameterized Constructors, Multiple Constructors in a class, Copy constructor, Destructors, Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Type Conversions.	5
V	**Inheritance and Polymorphism:** Introduction, Defining Derived Classes, Single inheritance, Multiple inheritance, Hierarchical inheritance, Multilevel inheritance, Hybrid inheritance, Virtual Base Classes, Polymorphism, static and dynamic binding, Constructor in Derived Classes, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions.	5

Text Books	1.	Object Oriented Programming in C++ -Robert Lafore, edition, Galgotia publications
	2.	The Complete Reference C++, Herbert Schildt, 4th Edition, TMH
E--Books	1.	Cryptography & network security by atul kahate https://www.pdfdrive.com/cryptography-network-security-by-atul-kahate-e124796757.html
Reference Books	1.	Let's C++ by Y. Kanetkar, BPB publications
	2	Object oriented programming with C++, E Balagurusamy, 4th edition, TMH

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Course Code	Name of Course	Course Category	Teaching Scheme				Credits						
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-V													
23BTCSL301	Formal Languages and Automata	PCC7	3			3	3	10	15	50			75
23BTCSL304/23BTCSP304	Operating System	PCC8	3		2	5	4	10	15	50	25	25	125
23BTITL301	Computer Networks	PCC9	2		2	4	3	10	15	50	25		100
23BTCSL311	Programme Elective Core1	PEC1	3		2	5	4	10	15	50	25		100
23BTCSL331/23BTCSP331	Multi-Disciplinary Minor:3	MD M3	3		2	5	4	10	15	50	25		100
23BTCSL332	Open elective -III	OE3	2			2	2	10	15	50			75
TOTAL			**16**		**8**	**24**	**20**	**60**	**90**	**300**	**100**	**25**	**575**

Course Title: **FORMAL LANGUAGES AND AUTOMATA**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC6	3 Hrs			3	10	15	50	NA	NA
Course Code	UNCSL301									
Teaching Mode	Offline	3 Hrs			Total	75				
Duration of ESE	2 Hrs 30 mins					75				

Course Objectives	To introduce the fundamental concepts of formal languages, grammars and automata theory.
	Classify machines by their power to recognize languages and use finite state machines to solve problems in computing.
	Use of Turing Machine and Pushdown Automata in Formal Language.
Course Outcomes	**CO1:** Understand the abstract machines and their power to recognize the valid Languages.
	CO2: Apply the knowledge of Automata Theory, Grammars & Regular Expressions for solving various problems
	CO3: Design context free grammars for formal languages.
	CO4: Analyze automata and their computational power to recognize languages.
	CO5: Solve the problems based on Turing Machine.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes:													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3		-	-	1	1		-	-	-	-	1	2	
CO2	-	3		3	2	2		-	-	-	-		3	3
CO3	-	3		3	2	-	-	-	-	-	-	1	3	3
CO4	-		3		2	1	-	-	-	-	-	-	3	
CO5	-		3		2	2	-	-	1	-	-	-	3	

Course Contents:

Unit	Contents	Hours
I	Introduction Basic Mathematical Notation and techniques: Finite State systems Basic Definitions Finite Automaton DFA & NDFA Finite Automaton with €-moves, Regular Languages, Regular Expression Equivalence of NFA and DFA Equivalence of NDFA"s with and without €-moves Equivalence of finite Automaton.	7
II	Regular Expressions: Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of Regular Languages Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages.	7

III	Context-Free Grammars: Chomsky hierarchy of languages. Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, Parse Tress, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.	7
IV	Push Down Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.	7
V	Turing Machine: Definitions of Turing machines Models ,Computable languages and functions, Techniques for Turing machine construction, Multi head and Multi tape Turing Machines, The Halting problem.	7

Text Books	1.	Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
	2.	Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.
E--Books	1.	"Formal languages and automata theory" by K V N Sunitha; N Kalyani, Publisher: Chennai : Pearson, [2015] ©2015
Reference Books	1.	Introduction to Languages and The Theory of Computation, John C Martin, TMH.
	2	Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
	3	A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
	4.	Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.
on line TL Material	1.	NPTEL Course Formal Language and Automata, IIT Guwahati https://nptel.ac.in/courses/111/103/111103016/

Department of Computer Science and Engineering

Course Title: **OPERATING SYSTEM**										
Semester	V	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC7	3 Hrs	NA	2 Hrs	4	10	15	50	25	25
Course Code	UNCSL304/ UNCSL304									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	2.30 Hrs					125				

Course Objectives	Introduces general idea, structure and functions of operating system
	Making students aware of basic mechanisms used to handle processes, memory, storage devices and files.
	Recent trends in the operating system
Course Outcomes	**CO1**: Understand basic structure and purpose of operating system.
	CO2: Interpret the concepts of process and illustrate various CPU scheduling algorithms.
	CO3: Apply the concepts of inter process communication.
	CO4: Schematize Deadlock & File System security mechanisms in operating systems.
	CO5: Analyze different memory management techniques with advantages and disadvantages.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	--	--	--	2	2	--	--	--	--	--	--	2	--
CO2	1	3	3	2	--	--	--	--	--	--	--	--	3	--
CO3	1	--	3	3	--	--	--	--	--	--	--	--	--	3
CO4	2	--	--	--	3	--	--	--	--	--	--	--	2	--
CO5	--	2	--	--	2	3	--	--	--	--	--	--	2	--

Course Contents:

Unit	Contents	Hours
I	**Introduction About OS:** Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation.	7
II	**Process & Scheduling** Process concept, process control block, Types of scheduler- FCFS, SJF, LJF, Priority Scheduling, Round Robin, SRTF,LRTF, context switch, threads, multithreading model, goals of scheduling and different scheduling algorithms,	7

III	**Process management and synchronization**: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, conditional critical regions and monitors, classical inter process communication problems	7
IV	**Deadlock & File System:** definitions, Prevention, Avoidance, detection and Recovery, Goals of Protection, access matrix, Deadlock implementation, File concept, Access methods space allocation strategies, disk arm scheduling strategies.	7
V	**Memory Management**: Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging, Virtual Memory Concepts, page faults and instruction restart, page replacement algorithms, working sets, Locality of reference, Thrashing, Garbage Collection.	7

Text Books	1.	Operating System concepts – Silberchatz; Galvin, Addison Wesley, 6thEdn.
	2.	Modern Operating Systems – Tanenbaum, Pearson Edn. 2nd edn
	3.	Operating Systems: Internals and Design Principles -- William Stallings
E--Books		https://ebooks.lpude.in/computer_application/mca/term_1/DCAP403_OPERATING_SYSTEM.pdf
Referenc e Books	1.	Operating Systems – S R Sathe, Macmillan Publishers, India, 2008
	2.	Operating System –Milan Milenkovik, McGraw-Hill, 1987
	3.	Operating Systems - 3 rd Edition by Gary Nutt, Pearson Education.
On-line TL Material	1.	https://nptel.ac.in/courses/106/108/106108101/

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Sr. No	Name of Experiment	CO Mapping
1	Perform a case study by installing and exploring various types of operating systems on a physical or logical (virtual) machine. (Linux Installation).	**CO1**
2	Implement of different types of system calls.	**CO1**
3	Write a program to implement FCFS,SJF and priority based Algorithm.	**CO2**
4	Write a program to implement Round Robin Algorithm.	**CO2**
5	Write a program to implement Producer Consumer Problem.	**CO3**
6	Write a program to implement Dining-Philosophers Problem.	**CO3**
7	Write a program to implement Bankers algorithm.	**CO4**
8	Write a program to implement Page Replacement.	**CO4**
9	Write a program to implement Memory management algorithm.	**CO5**
10	Write a program to implement Disk Scheduling algorithms.	**CO5**
Open Ended Practical List		
11	Write C programs to simulate Intra & Inter – Process Communication (IPC) techniques: Pipes, Messages, Queues and Shared Memory.	
12	Write C program to Perform Shell Programming.	

Department of Computer Science and Engineering

Course Title: **Computer Networks**										
Semester	IV	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	C10	3 Hrs	NA	2 Hrs	4	10	15	50	25	NA
Course Code	UCSL208/ UCSP208									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs					100				

Course Objectives	To understand the computer network architectures.
	To make aware of design and performance perspective of network architectures.
	To discuss current trends in communication
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Analyze the need for OSI reference model in computer networking
	CO2: Studying the various transmission medium used in physical layer
	CO3: Analyzing different Elementary protocols for communication and Identify IEEE standards employed in computer networking
	CO4: Solve and apply various Routing Algorithm and Protocols
	CO5: Use techniques involved in developing transport and application layer of computer networking.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO1 1	PO1 2	PS O 1	PS O 2
CO1	--	3	--	--	--	--	--	--	--	--	--	--	3	2
CO2	--	--	3	--	--	--	--	--	--	--	--	--	3	--
CO3	--	--	--	--	3	--	--	--	--	--	--	--	2	3
CO4	--	--	3	--	--	--	--	--	--	--	--	--	3	2
CO5	--	--	--	3	--	--	--	--	--	--	--	--	2	3

Course Contents:

Unit	Contents	Hours
I	Unit-I: Introduction The use of computer networks. Network hardware. LAN's, Man's, WAN's, internet works, Network software, protocol hierarchies, design issues for layers, interfaces and services, Connectionless oriented and connectionless services, service primitives, relationship of Services to protocols, the OSI reference model, TCP/IP reference model, comparison of OSI And TCP/IP reference model.	8
II	Unit-lI: Physical Layer The theoretical basis for data communication-Fourier analysis, bandwidth-limited signals, Maximum data rate of a channel, transmission media-magnetic media, and twisted pair coaxial Cable, fiber optics. Wireless transmission, microwave transmission. Multiplexing, switching, Narrow and ISDN - services, architecture, interface, perspective on N-ISDN, broadband ISDN & ATM-virtual circuits versus circuit switching, transmission in ATM networks, ATM Switches.	8
III	Unit-Ill: Data Link Layer Design issues - services provided to the network Layer, framing, error control, flow control, Error correcting & detecting codes, elementary data link protocols, simplex stop and wait Simplex protocols for noisy channel, sliding window protocols-one bit protocol, go back Protocol, selective repeat protocol. The medium access sub layer - static and dynamic channel Allocation in LANs and MANs, Multiple access protocols - ALOHA. CSMA, collision free Protocols, limited contention protocols, IEEE 802.11 wireless LAN protocols, IEEE Standards 802 for LAN and MANs-802.3 & Ethernet, token bus. Token ring,	8
IV	Unit-IV: The Network Layer Design issues, services provided to the transport layer, internal organization, comparison of Virtual circuit and datagram subnets, routing algorithms. Optimality principle, shortest path Routing, flooding, flow-based routing, distance vector routing, link state routing, hierarchical Routing, broadcast & multicast routing, congestion control algorithms, general principles Prevention policies, traffic shaping. flow specifications, congestion control in virtual circuit Subnets. choke packets, load shedding, jitter control. IP protocol, IP address. Subnets, internet Control protocols, OSPF. BGP.	8
V	Unit V: Transport and Application Layer Transport and Application Layer - services provided to the upper layer, Quality of Service, Transport service primitives, elements of transport protocols, addressing, establishing a Connection, releasing a connection, flow control & buffering, multiplexing, crash recovery,	8

Text Books	1.	Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, Pearson
	2.	Data Communication And Networking, Behrouz A. Forouzam, Fourth Edition, McGraw Hill
	3.	An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education
E--Books	1.	Fayez Gebali, Analysis of Computer and Communication Networks, First Edition, Springer
	2.	An Introduction to Computer Networks, Peter L Dordal, Department of Computer Science, Loyola University Chicago(http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf)
	3.	TCP/IP Network Administration, Craig Hunt
Reference Books	1.	Jean Walrand , PravinVaraiya, High-Performance Communication Networks (The Morgan Kaufmann Series in Networking), Second Edition, Morgan Kaufmann Publishers
	2.	V. S. Bagad, I. A. Dhotre, Computer Communication Networks, Third Edition, Technical Publications, Illustrated
	3.	Norman Abramson, Franklin F. Kuo, Computer-communication networks, Fourth Edition, Prentice-Hall, 1973, Illustrated
On-line TL Material	1.	Coursera – "Data communication Network Services" by Cisco
	2.	NPTEL – "Data Communication" by IIT Kharagpur
	3.	Swayam – "Computer Networks" by Anand More,

LIST OF PRACTICAL

Sr. no.	Practical List	Mapping with CO	Mapping with PO & PSO
1	To Study various communication devices and their roles at different layers	CO-1	PO1, PO2, PO11, PO12 and PSO2
2	To perform basic Networking commands.	CO-1	PO1, PO2, PO4, PO12 and PSO3
3	Write a program to implement Manchester Encoding technique.	CO-2	PO1, PO2, PO4, PO11, PO12 and PSO2
4	Write a program to determine the classes of IP Address (A, B, C, D, E)	CO-2	PO1, PO2, PO3, PO4, PO12 an PSO2, PSO3
5	Write a program to implement Bit-Stuffing in a frame.	CO-3	PO1, PO2, PO3, PO4, PO12 and PSO2, PSO3
6	Write a program to implement Character Stuffing in a frame.	CO-3	PO1, PO3, PO4, PO12 and PSO2, PSO3
7	Write a program forcreating sockets between client and server for communication	CO-4	PO1, PO2, PO4, PO11, PO12 and PSO2
8	Designing of different network topologies using NS2.	CO-4	PO1, PO2, PO3, PO4, PO12 and PSO2, PSO3
9	Configuration of the router using CISCO packet tracer.	CO-5	PO1, PO2, PO3, PO12 and PSO2,PSO3
	Practical Beyond Syllabus		
10	Implementation of RIP & EIGRP using CISCO packet tracer.	CO-2	PO1, PO3, PO4, PO12 and PSO2, PSO3
	Open Ended Experiments		
11	To capture and analyze packets using Wireshark Tool.	CO-4	PO1, PO2, PO4, PO12 and PSO3

Program Elective-I		
Sr. No	**Couse Code**	**Course Name**
1	[UNCSL310/UNCSP310]	CLOUD COMPUTING
2	UNCSL311/ UNCSP311	UNSTRUCTURED DATABASE MANAGEMENT SYSTEM
3	UNCSL313/UNCSP313	ADVANCED PROGRAMMING
4	UNCSL312/ UNCSP312	CODE REPOSITORY & VERSION CONTROL SYSTEM

Course Title: Cloud Computing										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC1	3 Hrs		2 Hrs	4	10	15	50	25	
Course Code	[UNCSL310/ UNCSP310]									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs 30 mins					100				

Course Objectives	To understand Cloud Computing concepts, technologies, architecture and applications
	To understand the underlying principle of cloud virtualization, cloud storage, data management and data visualization
	To understand different cloud programming platforms and tools to develop and deploy applications on cloud
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Describe fundamental concepts of cloud computing and identify key services offered by popular cloud platforms.
	CO2: Apply cloud development techniques to configure virtual machines, build private cloud environments, and deploy scalable cloud-based applications.
	CO3: Analyze the suitability of different PaaS environments for specific cloud applications and evaluate their performance for enterprise use cases.
	CO4: Design and develop cloud-based solutions tailored to enterprise needs by leveraging best practices and cloud technologies.
	CO5: Critically evaluate various cloud programming models and create innovative solutions to address complex real-world challenges using cloud infrastructure.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	--	3	2	--	--	--	2	--	--	--	--	--	3	--
CO2	1	--	--	2	3	--	--	--	--	--	--	--	3	--
CO3	--	--	3	--	--	--	--	--	--	--	--	--	3	--
CO4	--	--	--	3	--	--	--	--	--	--	--	--	--	2
CO5	--	--	--	--	3	--	--	--	--	--	--	--	--	2

Course Contents:

Unit	**Contents**	**Hours**
I	**Unit1: Introduction to Cloud Computing and Virtualization**: Virtualization Concepts, Cloud Computing Fundamental: Overview of Computing Paradigm, Evolution of cloud computing, Defining cloud computing, Components of a computing cloud, Essential Characteristics of Cloud Computing, Cloud Taxonomy. Infrastructure as a Service(IaaS),	7

	Platform as a Service(PaaS), Software as a Service (SaaS), Hardware-as-a-service: (HaaS), Oriented Architecture (SOA)	
II	**Unit 2 : Cloud Computing Architecture and Service Management in Cloud:** ComputingCloud architectural principles, Role of Web services, Benefits and challenges to Cloud architecture, Cloud Service Models, cloud computing vendors. Cloud Services, Management, Performance and scalability of services, tools and technologies used to manage cloud services deployment	8
III	**Unit 3 Data and Resource Management in Cloud Computing**: Data storage, migration, security, backup, and analytics, along with efficient resource allocation, auto-scaling, performance monitoring, cost optimization, and energy-efficient practices in cloud environments.	6
IV	**Unit 4 Cloud Security and Risk Management:** Cloud Security: Understanding cloud based security issues and threats, Data security and Storage, Identity& Access Management, Risk Management in cloud, Governance and Enterprise Risk Management.	7
V	**Unit 5 Open Source and Commercial Clouds:** Openstack, AWS, Google Cloud, Microsoft Azure, Cloud Simulator and IoT Cloud Framework, Research trend in Cloud Computing, Fog Computing,	7

Text Books	1.	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
	2.	Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
E-Books	1.	CLOUD COMPUTING Principles and Paradigms Link: http://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf
Reference Books	1.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
	2.	Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
online TL Material	1.	https://nptel.ac.in/courses/106/105/106105167/

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Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Implementation of IaaS Service using AWS Cloud	CO1
2	Explore of Cloud Service using Microsoft Azure Cloud	CO1
3	Install Type II virtualization using VM Ware's Workstation/ Oracle's Virtual Box and create virtual machine	CO2
4	Perform various configuration on virtual machine	CO2
5	Install Google App Engine. Create hello world app and simple web applications using python/java.	CO3
6	Install and Explore Open Source Cloud Platform Openstack	CO3
7	Simulate a cloud scenario using CloudSim	CO4
8	Explore Cloud Software as Service (SaaS) using SalesForce.com Sales	CO4
9	Creating an Application in SalesForce.com using Platform as Service(PaaS)	CO5
10	Implement container management with Kubernetes/Docker	CO5
Open Ended Experiments / New Experiments		
1	Explore different IoT Cloud Framework	
	Explore Fog/Edge Computing Framework	
Details of on line Laboratory Resource Material Instruction / Operating Manuals		
1	https://cloud.google.com/training	
2	https://trailhead.salesforce.com/en	
3	https://aws.amazon.com/	
4	https://azure.microsoft.com/en-in/	

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Course Title: **UNSTRUCTURED DATABASE MANAGEMENT SYSTEM**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC1	3 Hrs		2 Hrs	4	10	15	50	25	
Course Code	UNCSL311/ UNCSP311									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs 30 mins					100				

Course Objectives	To prepare students with fundamental knowledge and skills in unstructured data management
	To discuss various issues and challenges in unstructured data management.
	To provide the best practices, underlying principles, and emerging technologies in storing, retrieving, and analyzing unstructured data
Course Outcomes	CO1: Understand the characteristics of various data types and the challenges in managing and processing unstructured data
	CO2: Demonstrate different NoSQL database types with RDBMS, and apply data modeling techniques from conceptualization to schema definition
	CO3: Apply knowledge of Cassandra's architecture and data modeling techniques to design scalable and fault-tolerant database solutions
	CO4: Evaluate different CRUD operations in MongoDB, manage data types, and organize databases and collections to analyze database performance.
	CO5: Create and refine graph data models, and adeptly manage graph mutations such as adding and removing vertices and edges.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	2	3	-	3	-	-	-	-	-	-	-	-	2	2
CO3	-	3	3	-	-	-	-	-	-	-	2	-	-	-
CO4	2	-	3	-	3	-	-	-	-	-	-	-	-	-
CO5	2	-	-	3	-	-	-	-	-	-	-	-	2	2

Course Contents:

Unit	**Contents**	**Hours**
I	**Fundamentals of Unstructured Data:** Definition and characteristics of unstructured data, Comparison of structured, semi-structured, and unstructured data. Importance of unstructured data in modern analytics and applications.	7

	Overview of data formats: XML, JSON, CSV, and others. Challenges in managing and processing unstructured data.	
II	**NoSQL Databases and Architectures:** Introduction to NoSQL databases, Types of NoSQL databases: Document-oriented, Key-value, Column-family, and Graph databases. Comparison of NoSQL vs. RDBMS. Data Modeling: Conceptual Data modeling, RDBMS design, Logical Data Modeling, physical data Modeling, Evaluating and Refining, Defining database Schema.	9
III	**Cassandra:** Review of Relational databases, Sharding and Shared-Nothing Architecture, Web Scale, Rise of NoSQL, Distributed and Decentralized, Elastic Scalability, High Availability and Fault Tolerance, Tuneable Consistency, High Performance, Brewer's CAP Theorem, Cassandra's Data Model, CQL types, Other Simple Data Types, User-Defined Types	7
IV	**MongoDB architecture: I**ntroduction to mongo dB basics, core concepts and vocabulary, mongo dB databases, mongo dB collections, mongo dB documents. Mongo DB Data types, CRUD operations: Mongo DB create operations, Mongo DB read operation, Mongo DB update operations, Mongo DB delete operations, mongo DB bulk write operations	8
V	**Graph Database:** Introduction to graphs, Data modelling process, understanding the problem, developing the whiteboard model, constructing the logical data model, checking our model, Mutating a graph, creating vertices and edges, adding edges, removing a vertex, removing an edge	8

Text Books	1.	Kristina Chodorow and Michael Dirolf, "MongoDB: The Definitive Guide " (O'Reilly), 2010: ISBN: 978-1-449-38156-1
Reference Books	1.	Jeff Carpenter and Eben Hewitt, " Cassandra: The Definitive Guide Distributed Data at Web Scale" oreilly publications , revised third edition 2022
	2.	Dave Bechberger, Josh Perryman, "Graph Databases in Action " Manning publications 2020
	3.	Manu Sharma , " MongoDB Complete Guide" bpb publications, 1st edition 2021.
online TL Material	1.	https://www.udemy.com/course/learn-complete-nosql-dbs-hbasecassandramongodbredis/?srsltid=AfmBOorRfsHK0ab4BKHnU6_uyWEsdzpqAcNOgYXQ-NCjH1Tzgs7k-n3d&couponCode=BFCPSALE24
	2	Lecture 08: NoSQL Databases and Key Value Stores NPTEL: https://www.youtube.com/watch?v=-s29jUAkg70

Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Practical 1: Data Classification Aim: Develop Python scripts to classify provided data files as structured, semi-structured, or unstructured. Requirement: • Provide students with sample data files in various formats (e.g., .csv, .json, .xml, .txt, .pdf). • Ensure Python is installed on the lab computers along with necessary libraries (pandas, json, xml.etree.ElementTree, PyPDF2).	CO1
2	Practical 2: Format Conversion Aim: To understand and implement data conversion techniques between various formats (XML, JSON, CSV) and discuss their suitability for different types of applications.	CO1
3	Practical 3: MongoDB Setup and Basic Operations Aim: To gain familiarity with MongoDB installation and configuration, and to master basic database operations including creating, reading, updating, and deleting data.	CO2,CO4
4	Practical 4: Redis Key-Value Operations Aim: To learn how to set up and use Redis for key-value data storing and retrieval operations, understanding the speed and efficiency of in-memory databases.	CO2
5	Practical 5: Data Modeling with Cassandra Aim: To apply data modeling techniques in a column-family database system by designing and implementing a schema for an e-commerce application in Cassandra.	CO3
6	Practical 6: Advanced Queries in Cassandra Aim: To enhance proficiency in Cassandra by executing advanced queries and exploring features like tuneable consistency and performance optimization.	CO3
7	Practical 7: MongoDB Indexing and Bulk Operations Aim: To explore the impact of indexing on query performance in MongoDB and perform bulk operations to understand operational efficiency and scaling.	CO4
8	Practical 8: Neo4j Graph Database Introduction Aim: To introduce the concept of graph databases through the creation and manipulation of nodes and relationships in Neo4j, emphasizing data interconnectivity.	CO4
9	Practical 9: Graph Path Finding Aim: To apply graph traversal algorithms in Neo4j for pathfinding tasks, demonstrating the practical application of graph theory in solving real-world problems.	CO5
10	Practical 10: Graph Mutation Operations	CO5

	Aim: To understand the dynamics of graph databases through the addition and removal of elements, and to evaluate the impact of these mutations on overall database performance and query responses.	
	Open Ended practical	
1	Real-Time Processing and Storage of Sensor Data Using a Time-Series Database	
2	Analyzing the Scalability of Document-Based Databases for Big Data Applications	

Department of Computer Science and Engineering

Course Title: **ADVANCED PROGRAMMING**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC1	3 Hrs		2 Hrs	4	10	15	50	25	
Course Code	UNCSL313/UNCSP313									
Teaching Mode	Offline	5 Hrs			Total	**75**			**25**	
Duration of ESE	2 Hrs 30 mins					**100**				

Course Objectives	To provide students with a strong foundation in Java programming language by covering core principles such as object-oriented programming, exception handling, and multithreading.
	To enable students to design, develop, and deploy standalone, web-based, and enterprise-level applications using advanced Java technologies such as Servlets, JSP, JDBC, and frameworks like Spring and Hibernate.
	To develop problem-solving skills and equip students with the ability to apply Java programming concepts in building scalable and robust solutions to real-world engineering and computing challenges.
Course Outcomes	**CO 1:** Understand the syntax and structure of Java programming and its core principles.
	CO 2: Apply object-oriented programming concepts to solve real-world problems.
	CO 3: Establish database connectivity using JDBC and perform SQL operations programmatically.
	CO 4: Develop web-based applications using Servlets and JSP.
	CO 5: Create scalable enterprise-level applications using EJB and frameworks like Spring and Hibernate

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	--	--	--	2	--	--	--	--	1	2	2	--
CO2	2	--	3	2	3	2	--	--	--	--	2	2	3	--
CO3	2	3	3	2	--	2	--	--	--	--	--	2	--	3
CO4	2	--	3	--	2	2	--	--	--	--	--	2	2	--
CO5	2	--	2	--	3	2	--	--	--	--	2	2	2	--

Course Contents:

Unit	**Contents**	**Hours**
I	**Unit 1: Fundamentals of Java: Introduction to Java**:Overview and features of Java, JVM, JDK, and JRE, Java program structure and execution, Data types, variables, and operators, Control flow statements: if-else, switch, loops (for, while, do-while), **Object-Oriented Programming (OOP) Concepts**:	8

	Classes and objects, Constructors, Inheritance (single, multilevel, hierarchical), Polymorphism (method overloading and overriding), Abstraction and encapsulation.	
II	**Unit 2: Advanced Core Java Concepts: Exception Handling:** Types of exceptions, Try-catch-finally block, Throw, throws, and custom exceptions **Java Collections Framework:** Lists (ArrayList, LinkedList), Sets (HashSet, TreeSet), Maps (HashMap, TreeMap), **Multithreading**: Thread lifecycle, Creating threads (Thread class and Runnable interface), Synchronization and inter-thread communication, **File I/O**:File handling in Java, Reading from and writing to files	7
III	**Unit 3: Java Database Connectivity (JDBC):** Introduction to JDBC**:**JDBC architecture**,** Connecting to a database**,** Executing SQL queries**,** Result Set and metadata**, Transactions in JDBC:**Commit and rollback**,** Batch processing.	7
IV	**Unit 4: Web Technologies with Java: Servlets:** Introduction to servlets Lifecycle of a servlet, Handling HTTP requests and responses, Session tracking and cookies, **JavaServer Pages (JSP)**: JSP architecture and lifecycle Implicit objects, JSP scripting elements (declarations, scriptlets, expressions), Custom tags and tag libraries.	8
V	**Unit 5: Advanced Web Applications** Enterprise JavaBeans (EJB): Overview of EJB types (Session, Entity, Message-driven), Dependency injection, EJB lifecycle, **Spring Framework:** Basics, Dependency Injection (DI) and Inversion of Control (IoC), Spring Boot introduction, RESTful web services using Spring **Hibernate Framework**: ORM overview, Hibernate architecture, Configurations and mappings, CRUD operations with Hibernate.	6

Text Books	1.	"Java: The Complete Reference" by Herbert Schildt
	2.	"Head First Java" by Kathy Sierra and Bert Bates
	3	"Core Java Volume I – Fundamentals" by Cay S. Horstmann
E-Books	1.	"Thinking in Java" by Bruce Eckel (Available in digital format)
	2	"Effective Java" by Joshua Bloch
	3	Online Java eBooks Repository:
Reference Books	1.	"Java Programming and Data Structures" by Y. Daniel Liang
	2.	“Introduction to Java Programming, Comprehensive Version" by Y. Daniel Liang
	3.	"Advanced Java Programming" by Uttam K. Roy
online TL Material		**Oracle Java Tutorials:** https://docs.oracle.com/javase/tutorial/ Official documentation with tutorials on Java programming. **GeeksforGeeks Java Tutorials** https://www.geeksforgeeks.org/java/ Comprehensive resource for both core and advanced Java topics. **Java Programming on Coursera** https://www.coursera.org/ Offers free and paid courses on Java, including hands-on projects. **Java Programming by Udemy** https://www.udemy.com/

		High-quality video lectures covering core and advanced Java topics. **YouTube Channels** Programming with Mosh and Telusko: Popular YouTube channels with free tutorials on Java. **FreeCodeCamp Java Guide** https://www.freecodecamp.org/news/tag/java/ Beginner-friendly articles, guides, and resources.

Practical List:

Sr. No	Name of Experiments / Mini Projects/ Case Studies	Cos
1	Write a program to perform basic operations (addition, subtraction, multiplication, division) using control flow statements and loops.	CO 1
2	Develop a program to find the maximum, minimum, and average values in an array, and manipulate strings using inbuilt functions.	CO 1
3	Create a class for a Library Management System with attributes like book ID, title, author, and methods for adding, updating, and displaying book details.	CO 2
4	Implement a program demonstrating single and multilevel inheritance. Use method overriding to simulate an employee payroll system.	CO 2
5	Design an application to connect to a MySQL/Oracle database, create a table, insert, update, delete, and retrieve records.	CO 3
6	Develop a program to execute batch queries for inserting multiple records into a database table in a single operation.	CO 3
7	Develop a servlet to handle user login by validating credentials against a database. Include session tracking.	CO 4
8	Create a JSP page to display user details dynamically fetched from a database. Use MVC architecture.	CO 4
9	Develop an enterprise Java application using EJB to handle inventory management (session beans for logic and database interaction).	CO 5
10	Create a Spring Boot application to manage employee data. Use Hibernate for ORM and implement CRUD operations with RESTful web services.	CO 5
11	**Virtual Lab Practical** Core Java Programming **Platform:** Java Online Compiler **/ Virtual Labs by IITs** Basic Syntax and Control Structures Write, compile, and execute a Java program that uses control structures like if-else, switch, and loops (for, while, do-while). Advanced Java Programming **Platform:** JDBC Online Sandbox / Moodle with Virtual Environment Support Connect to a cloud-hosted database (e.g., MySQL on AWS RDS or Azure SQL). Perform operations such as table creation, insertion, deletion, and querying.	

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Course Title: **CODE REPOSITORY & VERSION CONTROL SYSTEM**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC1	3 Hrs		2 Hrs	4	10	15	50	25	
Course Code	UNCSL312/ UNCSP312									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs 30 mins					100				

Course Objectives	This course introduces the functionality and significance of a Code Repository in software development.
	To study various controlling structures for organizing commits with tags and branches
	To know the fundamental concepts of Code Repositories and Version Control Systems, emphasizing their role in collaborative development
Course Outcomes	**CO 1:** Understand the concepts of Code Repository and Version Control System.
	CO 2: Demonstrate the working of Code Repository and Version Control System
	CO 3: Analyze the Version Control System for the given application system
	CO 4: Determine the role of various controlling structures for organizing commits with tags and branches
	CO 5: Create and evaluate code repository and bug report

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	1	2	3		-	-	-	-	-	-	-	-
CO2	-	-	3	1	2	-	-	-	-	-	-	-	2	-
CO3	-	2	1	2	3	-	-	-	-	-	-	-	-	1
CO4	-	-	2	1	3	-	-	-	-	-	-	-	3	-
CO5	-	-	3	2	1	-	-	-	-	-	-	-	3	-

Course Contents:

Unit	**Contents**	**Hours**
I	Purpose & Terminology: Introduction of Basics Git terminology, Configure Git from the command line, using Git clone copy an existing Git Repository, Analysis of the current state of a repository with the powerful Git status, Create your first Git repository with Git init.	7
II	Git Repository: Git Object Model, Object Manipulation Commands, File system Layout, Choose Evoke Technologies for Consistent Deliverables.	6
III	Review a Repo's History and Commits: Examine the commit history of a repo's Git log, Customize the output of Git log's using command line flags in order to expose more (or less) information about each commit, Use the Git show command to display just one commit. Learn how to Use Git diff to discover what parts of a file have been modified in a commit, learn how to Use gitignore	8

	to mark files as "untracked", Learn the Git procedure and commits to a sample project.	
IV	Introduction to version control: Repositories and working copies, Distributed and centralized version control, Conflicts, Merging changes, Version control best practices, Use a descriptive commit message, Make each commit a logical unit, Avoid indiscriminate commits, Incorporate others' changes frequently, Share your changes frequently, Coordinate with your co-workers, Understand your merge tool, Obtaining your copy, Distributed version control best practices.	7
V	Git-bug and bug repository: Evolution of GitHub Issue Tracker, Installing git-bug, Features of the git-bug, Create a Bug Report for GitHub, Benefits of GitHub Bug Tracking, Content Integration, Content Delivery and Jenkins	7

Text Books	1.	Pro Git, 2nd Edition (Scott Chacon)
	2.	Learn Version Control with Git: A Step-by-Step Course for the Complete Beginner by Tobias Gunther
E--Books	1.	Version Control with Git, 2nd Edition, by Jon Loeliger, Matthew McCullough https://www.oreilly.com/library/view/version-control-with/9781449345037/
Reference Books	1.	Version Control with Git, 2nd Edition by Jon Loeliger, Matthew McCullough.
On line TL Material	1.	Version Control with Git https://www.coursera.org/learn/version-control-with-git
	2.	Version Control with Git, By Udacity https://www.careers360.com/courses-certifications/udacity-version-control-git-course
	3.	Continuous Integration - Version Control https://www.tutorialspoint.com/continuous_integration/continuous_integration_version_control.htm

Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Install Git and configure user name and email and initialize a Git repository and verify its creation	CO1
2	Clone an existing repository using the `git clone` command and analyze the repository structure and status using `git status`.	CO1
3	Demonstrate Git object model basics using commands like `git cat-file` and `git ls-tree` and explore the file system layout of a Git repository.	CO2
4	Explore add and commit commands with following tasks a)Add files to the staging area using `git add` and b)Commit changes with a descriptive commit message using `git commit`.	CO2
5	Explore view the commit history with `git log`. Use `git diff` to compare changes between commits or files.	CO3
6	Create new branches using `git branch` and switch between them using `git checkout` and merge changes from different branches and resolve conflicts.	CO3
7	Create a `.gitignore` file to exclude specific files or directories and verify the effect of `.gitignore` by running `git status`.	CO4
8	Demonstrate the use of `git stash` to temporarily save uncommitted changes. Apply or drop stashed changes from the stash list and use `git clean` to remove untracked files from the working directory.	CO4
9	Install and configure `git-bug` and create a sample bug report and manage it using `git-bug` commands.	CO5
10	Create a repository on GitHub and push local changes and open and manage issues on GitHub using the Issue Tracker.	CO5
Open Ended Experiments / New Experiments		
1	Deploy a Website Using GitHub Pages	
Details of online Laboratory Resource Material Instruction / Operating Manuals		
1	https://docs.github.com/en	
2	https://www.freecodecamp.org/news/git-and-github-for-beginners/	

MULTI-DISCIPLINARY MINOR(MDM-III)		
Sr. No	**Couse Code**	**Course Name**
1	UNCSLM308/UNCSPM308	RELATIONAL DATABASE
2	UNCSLM307/UNCSPM307	DATA STRUCTURES WITH C PROGRAMMING

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Course Title: **Relational Database**										
Semester	**V**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM3	3 Hrs		2 Hrs	4	10	15	50	25	25
Course Code	UNCSLM308 / UNCSPM308									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	2 Hrs 30 mins					125				

Course Objectives	This course introduces students to the concepts, theory, and applications of relational databases. Topics include database design, querying languages (like SQL), normalization, transaction management, and performance optimization. The course also explores advanced topics such as indexing.
	It is also aimed to developing skills to implement real life applications which involve database handling.
	This course also provide carrier opportunities in subject areas of designing, storage techniques and data handling and managing techniques
Course Outcomes	**CO1**: Understand the theory and concepts behind relational databases.
	CO2: Apply SQL queries to perform CRUD (Create, Retrieve, Update, and Delete) operations on database.
	CO3: Analyze the concept of functional dependencies and improve the database design using normalization.
	CO4: Evaluate the transaction management system, security and concurrency control.
	CO5: Explore hashing techniques for fast data access.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	--	--	--	--	--	--	--	--	--	--	2	--
CO2	2	--	3	2	3	--	--	--	--	--	--	--	3	--
CO3	2	3	3	2	--	--	--	--	--	--	--	--	--	3
CO4	2	--	3	--	2	--	--	--	--	--	--	--	2	--
CO5	2	--	2	--	3	--	--	--	--	--	2	--	2	--

Course Contents:

Unit	Contents	Hours
I	Introduction to DBMS ,Advantages of DBMS over the traditional file systems ,Types of databases: Relational, NoSQL, Hierarchical, and Network, Key components of an RDBMS,Database Design Process: Entity-Relationship (ER) model, Basic data models and schemas, Concept of Keys(Super key ,candidate key, primary key ,secondary key),Integrity Constraint.	5
II	SQL Concepts - Basics of SQL, DDL, DML, DCL, structure – creation, alteration, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, Use of group by, having, order by, join and its types, sub-queries, correlated sub-queries, Exist, Any, All.	9
III	Functional Dependency (FD) – Basic concepts, closure set of FD, Minimal cover of FD, closure of attribute set, Normalization – 1NF, 2NF, 3NF, BCNF.	8
IV	Transaction concepts, ACID properties of transactions, Transaction control commands–Commit, Rollback, Save point. Schedules, Serializability, Concurrency control, Two-phase locking protocol.	8
V	Indexing and hashing, Query processing, Query Optimization, Data Mining, Advances in databases	5

Text Books	1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002.
	2.	Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.
E-Books	1.	https://ebooks.lpude.in/computer_application/mca/term_1/DCAP204_MANAGING_DATABASE_DCAP402_DATABASE_MANAGEMENT_SYSTEMS.pdf
Reference Books	1.	G. K. Gupta :"Database Management Systems", McGraw – Hill.
	2.	Regina Obe, Leo Hsu, PostgreSQL: Up and Running, 3rd Ed, O'Reilly Media 2017.
	3.	Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O'Reilly Media 2018.
	4.	RamezElmasri and ShamkantNavathe, Fundamentals of Database Systems 2nd Ed, Benjamin Cummings, 1994.
online TL Material	1.	https://nptel.ac.in/courses/106/105/106105175/

Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Identification of Project. Draw E-R diagram and convert entities and relationships to relation based on project (eg. Food ordering management system, college management system, Online shopping system, Hotel management etc)	CO1
2	To perform following SQL activity on the project: a) Creating a database b) Creating Tables (With keys and Constraints) c) Inserting Records in tables	CO1

3.	To add constraints to table(Key constraint, CHECK constraint, NOT NULL Constraint, Referential integrity constraint)	CO2
4	To Perform the following: Viewing all databases, Viewing all Tables in a Database, Updating/Deleting Records in a Table, Altering a Table, Dropping/Truncating/Renaming Tables,	CO2
5	To Perform the following SQL query on database: Simple Queries with Aggregate functions, Queries with Aggregate functions with group by, having clause and order by clause	CO3
6	To Perform the following SQL query on database: SQL query that demonstrate Join operations-Inner Join, Outer Join, Left join, Right Join	CO3
7	To Perform the following SQL query on database: SQL query that demonstrate following- Sub-queries, Subqueries- with IN, EXISTS and ANY/ALL clause	CO4
8	SQL query that demonstrate following-Views with its various operations	CO4
9	To perform SQL query to understand the concepts: Transaction, ROLL BACK, COMMIT & CHECK POINTS.	CO5
10	SQL query that demonstrate following-Triggers	CO5
	Open Ended Experiments / New Experiments	
1	Open ended practical on NOSQL	
2	Name of case based practical: Develop one menu driven project for management of database system: 1. Library information system a. Engineering b. MBA 2. Inventory control system a. Computer Lab b. College Store 3. Student information system a. Academic b. Finance 4. Time table development system a. CSE, IT & MCA Departments b. Electrical & Mechanical Departments	
Details of online Laboratory Resource Material Instruction / Operating Manuals		
1	http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/exp5/index.php	
2	http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/exp3/index.php	

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Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VI													
23BTCSL303/23BTCSP303	Design and Analysis of Algorithms	PCC9	3		2	5	4	10	15	50	25	25	125
23BTCSL307	Data Mining and Warehousing	PCC12	3		2	5	4	10	15	50	25	25	125
23BTCSL321 23BTCSL322 23BTCSL323 23BTCSL324	Programme Elective Core2 1)Salesforce 2)Big Data Computing 3) User Interface Design 4) Blockchain Technology	PEC2	3		2	5	4	10	15	50	25		100
23BTCSL331 23BTCSL332 23BTCSL333	Programme Elective Core3 1)Agile Scrum Master 2)Mobile Computing 3)Distributed Computing	PEC3	4			4	4	10	15	50			75
23BTCSL308	Multi-Disciplinary Minor-IV(Introduction to Cloud Computing)	MDM4	2			2	2	10	15	50			75
23BTCSL309	Vocational andSkill Enhancement Elective – IV(Web Technology)	VSEC4	1		2	3	2	10	15		25	-	50
23BTSHP302	Research Methodology	RM			4	4	2				50		50
TOTAL			16		12	28	22	60	90	250	150	50	600

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Course Title: Design and Analysis of Algorithms										
Semester	VI	Teaching Scheme				Evaluation Scheme				
Term	EVEN					Theory			Practical	
Course Category	PCC9	Th	Tu	Pr	Credits	TAE	CAE	ESE	Int	Ext
Course Code	23BTCSL303/23BTCSP303	3 Hrs	NA	2 Hrs	4	10	15	50	25	25
Teaching Mode	Offline									
Duration of ESE	3 Hrs	5 Hrs			Total	75			50	
						125				

Course Objectives	This course introduces students the general idea of analysis and design of algorithms while making them aware of basic methods of algorithm analysis and design.
	It is also aimed at developing skills to solve real life applications which involve algorithm development
	The course also provides career opportunities in analysis, design, and optimization technique in algorithms
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Understand basic concepts of algorithm in analysis and Design of algorithms and Examine Recurrence relations, solutions of recurrence of searching sorting methods
	CO2: Apply Greedy methods used for analysis and Design of Algorithm.
	CO3: Analyze Dynamic Programming concepts in designing algorithm.
	CO4: Describe Branch & Bound concepts in designing algorithm.
	CO5: Evaluate advanced techniques and tools available for algorithm analysis and development

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	--	--	--	--	--	--	--	--	--	--	2	--	
CO2	--	3	--	--	--	--	--	--	--	--	--	--	1	--	
CO3	--	--	--	3	--	--	--	--	--	--	--	--	2	--	
CO4	--	--	3	--	--	--	--	--	--	--	--	--	3	--	
CO5	--	--	--	--	3	--	--	--	--	--	--	--	--	3	

Course Contents:

Unit	Contents	Hours
I	**Unit – I: Introduction of Algorithms** Analysis of algorithms: Space Complexity, Time Complexity, recurrence relation and Asymptotic Notation, Divide and Conquer: General Methods, Analysis and Design, Binary Search, Quick sort, Merge sort, Strassen's matrix multiplication.	7
II	**Unit – II: Greedy Strategy** Introduction, examples of greedy method like optimal merge pattern, Huffman coding, Minimum spanning trees, knapsack problem, job sequencing with deadlines single source shortest path algorithms.	7
III	**Unit – III: Dynamic Programming** Introduction, Problem based on this approach such as 0/1 Knapsack, Multistage graph, Floyd-warshall algorithms, Job sequencing with deadlines problem, single source shortest path, optimal binary search trees.	7
IV	**Unit IV: Backtracking & Branch & Bound** Backtracking concept and its example like 8 Queen's problem, Hamiltonian cycle, Graph coloring problem, 15 Puzzle problem, Least Cost Search. Introduction to branch & bound method, examples of branch & bound methods like traveling sales man problem, meaning of lower bound theory and its use in solving algebraic problem. Concept of graph, traversal techniques and its operations.	7
V	**Unit V: P NP Class** P, NP-completeness & NP hard problems. Basic Concept of non-deterministic algorithms. NP hard and NP complete classes, Polynomial reduction.	7

Text Books	1.	Thomas H. Cormenet. al. "Introduction to Algorithms," Prentice Hall of India.
	2.	Design & Analysis of Computer Algorithms by Aho, Horowitz, Sahani, Rajsekharam, Pearson education
E Books	1	Algorithms: Design and Analysis By Harsh Bhasin, All it Books .net.
	2	Advanced Algorithms by Prof. Michel Goemans.

Reference Books	1.	"Computer Algorithms", Galgotia Publications Pvt. Ltd. Brassard, Bratley, "Fundamentals of Algorithms", Prentice Hall
	2.	Computer Algorithms: Introduction to Design and analysis, 3rd Edition, By Sara Baase& A. V. Gelder Pearson Education.
On-line TL Material	1.	NPTEL course on Design and Analysis of Algorithms: https://www.class-central.com/course/nptel-design-and-analysis-of-algorithms-3984

Sr. No.	Name of Practicals
1	To Implement and analyze time complexity of Searching & sorting Algorithm.
2	To Implement Strassen Matrix multiplication on the given matrix.
3	To Implement and analyze time complexity of optimal merge pattern
4	To Implement and analyze time complexity of Job sequencing problem.
5	To Implement and analyze time complexity of Floyd warshall algorithm.
6	To implement and analyze time complexity of Single source shortest path Algorithm.
7	To implement and analyze 8-queen problem using backtracking.
8	To implement and analyze 0/1 knapsack using branch and bound.
9	To implement and analyze time complexity of BFS Algorithm.
10	To implement and analyze time complexity of DFS Algorithm.
Open Ended Experiments / New Experiments.	
1	Open-Source Practical: NP Complete
2	Open-Source Practical: Graph Coloring
Details of on-line Laboratory Resource Material Instruction / Operating Manuals	
1	Virtual Lab: Graphs traversing https://virtual-labs.github.io/exp-bfs-iiith/bfs/bfs_demo.html
2	**Virtual Lab:** Spanning Trees http://cse01- iiith.vlabs.ac.in /exp9/Introduction.html?domain=Computer%20Science&lab=Data%20Structures

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Course Title: Data Mining and Warehousing										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PCC10	3 Hrs		2 Hrs	4	10	15	50	25	25
Course Code	23BTCSL307/ 23BTCSP307									
Teaching Mode	Offline	5 Hrs			Total	75			50	
Duration of ESE	3 Hrs					125				

Course Objectives	1. To understand the principles concepts and applications of of Data warehousing and Data Mining.
	2. Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
	3. Develop skill in selecting the appropriate data mining algorithm for solving practical problems. To perform classification and prediction of data.
Course Outcomes	**CO1**: Understand the functionality of the various data mining and data warehousing component
	CO2: Characterize the kinds of patterns that can be discovered by association rule mining.
	CO3: Describe warehousing architectures and tools for systematically organizing large database and use their data to make strategic decisions.
	CO4: Discover interesting patterns from large amounts of data to analyze for predictions and classification.
	CO5: Apply the techniques of clustering, classification, association finding, feature selection and visualization to real world data

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	2	1	--	--	--	--	--	--	--	--	--	--	--	
CO2	2	--	2	--	--	--	--	--	--	--	--	--	--	--	
CO3	2	2	--	2	--	--	--	--	--	--	--	--	2	3	
CO4	--	--	--	2	2	--	--	--	--	--	--	2	--	--	
CO5	--	3	--	--		--	--	--	--	--	2	--	3	--	

Course Contents:

Unit	Contents	Hours
I	**Introduction to data mining**: Motivation, Importance, Definition of Data Mining, Kind of Data, Data Mining Functionalities, Kinds of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Major Issues In Data Mining, Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems.	8
II	**Data Warehouse**: Introduction to Data Warehouse, characteristics, Architecture and its components, Extraction-Transformation-Loading, Logical, Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP.	7
III	Data Mining Functionalities – Data Pre-processing, Data Quality, Major Tasks in Data Preprocessing, Data Reduction, Data Discretization and Concept Hierarchy Generation- Association Rule Mining, Efficient and Scalable Frequent Item set Mining Methods , Mining Various Kinds of Association Rules, Correlation Analysis , Constraint-Based Association Mining.	7
IV	**Classification:** Classification techniques, Decision trees, Naïve-Bayes Classifier, Bayesian Belief Networks; K-nearest neighbor classification, **Cluster Analysis** - Types of Data in Cluster Analysis, Partitioning Methods, and Hierarchical methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint Based Cluster Analysis, and Outlier Analysis.	8
V	Mining Object, Spatial, Multimedia, Text and Web Data - Multidimensional Analysis and Descriptive Mining of Complex Data Objects, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web.	5

Text Books	1.	Jiawei Han, Micheline Kamber and Jian Pei"Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011.
	2.	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
E-Books	1.	https://dl.ebooksworld.ir/motoman/Cambridge.University.Press.Data.Mining.and.Data.Warehousing.www.EBooksWorld.ir.pdf
Reference Books	1.	G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
	2.	Margaret H Dunham (2006), Data Mining Introductory and Advanced Topics, 2nd edition, Pearson Education, New Delhi, India.
	3.	Amitesh Sinha (2007), Data Warehousing, Thomson Learning, India.
	4.	Xingdong Wu, Vipin Kumar (2009), the Top Ten Algorithms in Data Mining, CRC Press, UK
online TL Material	1.	https://onlinecourses.nptel.ac.in/noc21_cs06/preview

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Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Perform the statistical analysis of data. Discretization, Missing Values, Numeric Transform, using WEKA Explorer	CO1
2	Demonstration of association rule mining using apriori algorithm on supermarket data use weka.associations.Apriori	CO1
3	Created a decision tree by using J48 Technique for the complete dataset as the training data in Weka Explorer. Use German credit data set arff file. Report the model obtained after training	CO2
4	Determining and classifying the credit good or bad in the dataset with an Accuracy. Use your above model trained on the complete dataset, and classify credit good/bad for each of the examples in the dataset	CO2
5	Perform an experiment to test the cross validation for analyzing the data.	CO3
6	Perform an experiment to correctly classified instances, root mean squared error, kappa statistics, and mean absolute error for weather data set with Weka mining tool	CO3
7	Perform classification using Bayesian classification algorithm using R.	CO4
8	Perform the cluster analysis by k-means method using R.	CO4
9	To apply the web mining technique clustering algorithm for the given dataset.	CO5
10	Perform an experiment to find association between data and to find the frequent item set for text mining.	CO5
Open Ended Experiments / New Experiments		
1	**Data Clustering: K-means, MST based** https://cse20-iiith.vlabs.ac.in/exp/mst-based/	CO5

Department of Computer Science and Engineering

Programme Elective Core-2

Course Title: SALESFORCE										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3 Hrs		2 Hrs	4	10	15	50	25	
Course Code	23BTCSL321/ 23BTCSP321									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs					100				

Course Objectives	1. To provide a foundational understanding of Salesforce concepts, tools, and applications, enabling learners to manage and develop Salesforce platforms effectively.
	2. To equip learners with the skills to configure Salesforce orgs, automate business processes, and implement data security and access controls.
	3. To develop proficiency in Salesforce development tools, including Apex, Lightning Web Components, and integration frameworks, for building robust and scalable applications.
Course Outcomes	CO1: Understand the Salesforce ecosystem, its architecture, and the platform's key features, demonstrating knowledge of its role in enterprise solutions.
	CO2: Design and implement data models, security controls, and automation processes to meet specific business requirements in Salesforce
	CO3: Develop and test Apex classes, triggers, and Lightning Web Components, ensuring scalability and adherence to Salesforce development
	CO4: Analyze and troubleshoot data management, user experience, and integration challenges using Salesforce tools and techniques.
	CO5: Create reports, dashboards, and integrated workflows using Salesforce to enhance decision-making

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	--	--	--		--	--	--	--	--	--	2	--	
CO2	-	--	3	2	3	--	--	--	--	--	--	--	3	--	
CO3	-	2	3	2	--	--	--	--	--	--	--	--	--	3	
CO4	-	--	3	--	2	--	--	--	--	--	--	--	2	--	
CO5	-	--	2	--	3	--	--	--	--	--	2	--	2	--	

Course Contents:

Unit	Contents	Hours
I	**Salesforce Basics and Platform Overview:** Introduction of Salesforce ecosystem, its editions, and pricing models. Fundamentals of multitenancy and metadata-driven architecture Salesforce's cloud offerings, the AppExchange, and the platform's navigation. Basic org setup, profiles, roles, and permissions, developer console.	7
II	**Data Modelling and Security:** Understanding standard and custom objects, field types, and relationships, including master-detail and lookup. Schema design with schema builder, permission sets, role hierarchies, and sharing rules, record-level security and Salesforce shield basics and data management practices, validation rules, and handling duplicate records.	8
III	**Business Logic and Automation:** Automation tools, Workflow Rules, Process Builder, and Flow Builder, Introduces Apex programming, classes, triggers, and SOQL/SOSL queries, approval processes and their automation using flows.	6
IV	**User Experience and Advanced Development:** UI customization, Page layouts, compact layouts, and dynamic forms. Introduction of the Lightning Web Components (LWC) Bulk triggers, governor limits, and exception handling. Deployment tools like Change Sets and Salesforce CLI.	7
V	**Integration and Analytics:** Introduces Salesforce APIs (REST, SOAP, Bulk) and integration patterns. External objects and Salesforce Connect. Report and dashboard creation, including filters and custom report types. Einstein Analytics and its applications.	7

Text Books	1.	**Salesforce for Beginners"** by Sharif Shaalan
	2.	**Mastering Salesforce Administration"** by Rakesh Gupta
E-Books	1.	https://resources.docs.salesforce.com/latest/latest/en-us/sfdc/pdf/sales_core.pdf
Reference Books	1.	**Learning Apex Programming"** by Matt Kaufman and Sagar Pareek
	2.	**Advanced Apex Programming in Salesforce"** by Dan Appleman
online TL Material	1.	https://trailhead.salesforce.com/

Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Create a new Salesforce Developer Org, configure company settings, and set up user profiles with specific roles and permissions.	CO1
2	Create custom objects for project with fields. Establish relationships (Lookup and Master-Detail) between objects as per requirement of project.	CO1
3	Implement a validation rule and formula fields for project.	CO2
4	Use Workflow Rules to send email alerts or update fields automatically based on specific criteria.	CO2
5	Automate a business process using Process Builder, such as updating records or triggering actions.	CO3
6	Create a Flow to collect user inputs and update related records dynamically.	CO3
7	Import, update, and delete records using Data Import Wizard and Data Loader while managing data integrity.	CO4
8	Write a simple Apex trigger to perform actions, such as creating or updating related records automatically.	CO4
9	Create custom reports and dashboards to visualize business data, such as different trends or performance metrics.	CO5
10	Use Change Sets to migrate customizations (objects, workflows, and fields) from one Salesforce org to another.	CO5
Open Ended Experiments / New Experiments		
1	Design and implement a custom Salesforce application, including custom objects, business logic, and automation, to solve a real-world problem.	
2	Develop an integration to consume an external REST API, process the data, and store it in a Salesforce custom object.	
Details of online Laboratory Resource Material Instruction / Operating Manuals		
1	https://trailhead.salesforce.com/content/learn/trails/force_com_admin_beginner	
2	https://trailhead.salesforce.com/users/strailhead/trailmixes/prepare-for-your-salesforce-platform-developer-i-credential	

Department of Computer Science and Engineering

Course Title: **Big Data Computing**										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category / Course Code	23BTCSL322 23BTCSP322	3Hrs.	--	2Hrs.	4 Credits	10	15	50	25	-
Teaching Mode	Offline	5 Hrs per Week			Total	75 Marks			25 Marks	
Duration of ESE	3 Hrs.					100 Marks				

Course Objectives	1. Introduction of basic concepts and techniques of Big data. 2. To Learn Hadoop Distributed File System (HDFS) & its applications 3. Understand MapReduce and its qualities and retain advanced MapReduce thoughts.
Course Outcomes	Upon successful completion of this course, student will be able to: CO 1. Acquire basic concepts and techniques of Hadoop and Big data computing. CO 2. Develop skills for implementation of various Hadoop ecosystem component. CO 3. Shall able to apply ecosystem knowledge to real time problems of moderate complexity. CO 4. Implement and Design different Big Data framework. CO 5. Implementing data science and big data analysis in various applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		2	3	-	3	-	-	-	-	-	-	-	-	2	2
CO2		2	3	-	3	-	-	-	-	-	-	-	-	3	2
CO3		3	3	-	3	-	-	-	-	-	-	-		2	3
CO4		3	3	-	3	-	-	-	-	-	-	-		3	3
CO5		3	3	-	3	-	-	-	-	-	-	-	-	3	2

Unit	Contents	Hours
I	**Unit I: Big data and Hadoop:**Introduction to Hadoop and Big Data, Big data, challenges for processing big data, technologies support big data, History of Hadoop, Use cases of Hadoop, RDBMS vsHadoop When to use and when not to use Hadoop.	8
II	**Unit II: HDFS:**Hadoop Distributed File System, Significance of HDFS in Hadoop, Features of HDFS,Data Storage in HDFS: Introduction about Blocks, Data replication. Accessing HDFS:CLI (Command Line Interface) and admin commands, Java Based Approach, Fault tolerance. Download Hadoop, Installation and set-up of Hadoop., Start-up & Shut down process	8
III	**Unit III: Map Reduce :**Map Reduce: Map Reduce Story, Map Reduce Architecture, How Map Reduce works, Developing Map Reduce, Map Reduce Programming Model, Different phases of Map Reduce Algorithm, Different Data types in Map Reduce	8
IV	**Unit IV: Pig And HIVE:**Introduction to Apache Pig, Map Reduce Vs. Apache Pig, Modes of Execution in Pig, Loading data, Exploring Pig Latin commands, HIVE: Hive introduction, Hive architecture, Data types and schemas, Partitions and buckets, Concept of HBASE.	8
V	**Unit V: Spark :**Spark Shell, Spark Application, Flume, SQOOP introduction and application.	8

Text Books	1.	Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly Media.
	2.	Big Data (Black Book), Wiley
E-Books	1.	BigData Now current perspective from O'Reilly Media
	2.	Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer
References Books	1.	V. Ankam, Big Data Analytics, Packt Pub Ltd.
	2.	N. Dasgupta, Practical Big Data Analytics, Packt Pub Ltd.
on line TL Material	1.	https://www.udemy.com/big-data-hadoop-the-complete-course/
	2.	https://www.cloudera.com/more/training/certification.html
	3.	https://www.edureka.co/big-data-and-hadoop https://www.simplilearn.com/big-data-and-analytics/big-data-and-hadoop-training

Sr. No.	Name of the Experiments	Course Outcomes
1	To install Hadoop framework, configure it and setup a single node cluster. Use web based tools to monitor your Hadoop setup	CO1
2	To implement file management tasks in Hadoop HDFS like adding, retrieving and deleting files	CO1
3	To implement a word count application using the MapReduce API.	CO2
4	Creating the HDFS tables and loading them in Hive	CO2
5	To create HDFS tables and load them in Hive and implement joining of tables in Hive.	CO3
6	To install, deploy & configure Apache Spark Cluster. To Select the fields from the dataset using Spark SQL. To explore Spark shell and read from HDFS	CO3
7	To install and run Pig and then write Pig Latin scripts to sort, group, join, project, and filter your data.	CO4
8	To perform Graph analytics and visualization using Tableau.	CO4
9	To implement basic functions and commands in R Programming. better visualization than a data table.	CO5
10	To use following platforms for solving any big data analytic problem of your choice. (1) Amazon web services,(2) Microsoft Azure, (3)Google App engine	CO5

Department of Computer Science and Engineering

Course Title: **User Interface Design and User Experience**										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3 Hrs.	NA	2	4	10	15	50	25	NA
Course Code	23BTCSL323 23BTCSP323									
Teaching Mode	Online	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs.					100				

Course Objectives	To analyze an interaction design problem and propose a user-centered process, Justifying the process and identifying the trade-offs.
	To create a high quality, professional documentation and artifacts relating to the Design process for preparation for a professional portfolio.
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1: Describe the Characteristics of User Interface design and its Principles
	CO2: Discuss the issues and challenges for achieving a user-centered design process, especially with regard to prototyping and evaluation techniques.
	CO3: Use, adapt and extend design standards, design components, guidelines, and patterns focusing on user experience.
	CO4: Identify best practices of web color management, principles of designing APP, and web usability in designing responsive web pages.
	CO5: Create storyboards, video scenarios, and experience prototypes for a small system and plan and perform a real world deployment study of a user experience.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O 2	PS O3
CO1	3	--	--	--	--	--	--	--	1	--	--	1	2	1	
CO2	--	3	--	--	--	--	--	--	1	--	--	2	2	1	
CO3	--	--	3	--	--	--	--	--	2	--	--	2	3	2	
CO4	--	--	3	--	--	--	--	--	2	--	--	2	3	3	
CO5	--	--	--	--	3	--	--	--	3	--	--	3	2	3	

Course Contents:

Unit	Contents	Hours
I	**Introduction:** - Introduction to User Interface Design (UI), Brief History of UI Design. Human Computer Interface, Characteristics of Graphics Interface, Direct Manipulation Graphical System, Web User Interface: Popularity, Characteristic & Principles.	9
II	**User Design Process:** - Introduction to design process, User centered design process, Usability Engineering and Task centered Approaches. Introduction to Design centered Approaches, Design Centered Methods. Prototyping in practice- Design rationale and Evaluation techniques, Model View Controller Framework(MVC).	10
III	**User Experience design** component in Interface Design, Visual Communication design component in Interface Design. System menus and navigation schemes, Structures of menus, Functions and contents of menus, Formatting, Phrasing, Navigating, Selecting menu choices, and kinds of graphical menus. Windows: Characteristics components presentation styles Type's Management's organizations operations. Web systems device based controls, characteristics Screen -based controls, operate control - text boxes-selection control combination control-custom and control-presentation control.	10
IV	**Web Design,** Design techniques such as scenarios, personas, storyboards, wire framing, and information architecture. App Design and its principles. Prototyping tools, both low-fidelity and high-fidelity. Design for small screens, responsive design. Non-GUI design (e.g., auditory interfaces, gesture interfaces). Understanding the Designing language of Desktop, Web and Mobile. Flow & Layout & Organizational structures. Swing Programming Introduction& Widgets. UI Widgets & Input Devices.	10
V	**Case Studies** and Best Practices based on advance and recent technology for designing UI/UX.AI and Animation tools like-CANVA, AdobeXD, Figma etc	6

Text Books	1.	Wilbent. O. Galitz ,"The Essential Guide to User Interface Design", John Wiley& Sons, 2001.
	2.	Ben Sheiderman, "Design The User Interface", Pearson Education, 1998.
E--Books	1.	https://www.uxpin.com/studio/ebooks/ux-design-definitive-beginner-guide-signup/
	2.	https://www.userfocus.co.uk/fable/index.html
Reference Books	1.	Greenberg, S., Carpendale, S., Marquart, N., and Buxton, B. (2011) Sketching User Experiences: The Workbook. San Francisco: Morgan
	2.	Alan Cooper, "The Essential Of User Interface Design", Wiley – Dream Tech Ltd.,2002.
	3.	Buxton, B. (2007) Sketching User Experiences. Sketching User Experiences. San Francisco: Morgan Kaufmann. (Amazon)
on line TL Material	1.	Introduction to UI Design ,https://www.coursera.org/learn/ui-design?
	2.	Introduction to User Experience Design https://www.coursera.org/learn/user-experience-design

Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	Identification of Project. Conduct a survey to understand user needs for a basic app (e.g., fitness or to-do app). Based on the results, create 2–3 personas that represent typical users, including demographics, goals, and pain points.(**Tool**: Google Forms, SurveyMonkey for surveys; Miro for persona development.)	CO1
2	To perform following activity on the project: Choose 2–3 similar applications, analyze their strengths and weaknesses, and summarize findings. Create a mood board with inspiring UI elements to guide your own design.(**Tool**: Pinterest or Dribbble for design inspiration; Miro or Notion for documentation.)	CO1
3	To Perform the following: Map a user's journey in completing a task within an app, like signing up or making a purchase. Identify the steps involved, user emotions, and pain points along the journey. (**Tool**: Miro or Lucidchart.)	CO2
4	To Perform the following Create a site map for a small app or website (e.g., an e-commerce platform) showing the primary pages and their relationships. Ensure logical navigation paths for different user goals.(**Tool**: Figma or Miro for creating site maps.)	CO2
5	To Perform the following Develop wireframes for the main screens (e.g., homepage, product page, checkout page) of the app or website. Focus on layout and positioning of elements without detailed design.(**Tool**: Balsamiq or Figma.)	CO2
6	Convert the wireframes into a high-fidelity prototype by adding design details, colors, typography, and interactive components. Use real data where possible for authenticity. (**Tool**: Figma or Adobe XD.)	CO2, CO3
7	Create a basic design system, including a color palette, typography, button styles, and iconography. Document component usage guidelines for consistency across the interface.(**Tool**: Figma for component libraries.)	CO3
8	Create responsive versions of key screens (desktop, tablet, and mobile) by adjusting layouts and components to fit different screen sizes. Focus on usability for each device.(**Tool**: Figma for responsive layouts.)	CO4
9	Evaluate your high-fidelity prototype for accessibility issues, such as color	CO4

	contrast and text size. Make adjustments based on WCAG (Web Content Accessibility Guidelines) standards.(**Tool**: Stark (Figma plugin) for color contrast checking.)	
10	Open Ended Practical :Design microinteractions for actions like button clicks, loading indicators, and form submissions. Add animations that enhance usability without overwhelming the user. (**Tool**: Figma (Prototyping) or Adobe After Effects for detailed animations.)	CO5
Open Ended Experiments / New Experiments		
1	Name of case based practical: Develop a Home page and registration page. 1. Library information system a. Engineering b. MBA 2. Inventory control system a. Computer Lab b. College Store 3. Student information system a. Academic b. Finance 4. Time table development system a. CSE, IT & MCA Departments b. Electrical & Mechanical Departments etc.	
Details of online Laboratory Resource Material Instruction / Operating Manuals		
1	https://www.geeksforgeeks.org/user-experience-or-ux-design/	
2	https://www.learnui.design/blog/identifying-fonts.html	
3	https://webflow.com/blog/ui-ux-design-tools	
4	https://www.w3schools.com/css/css3_user_interface.asp	

Department of Computer Science and Engineering

Course Title: **BLOCKCHAIN TECHNOLOGY**										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC2	3 Hrs		2 Hrs	4	10	15	50	25	
Course Code	23BTCSL324/ 23BTCSP324									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	2 Hrs 30 mins					100				

Course Objectives	1. Understand how blockchain systems (mainly Bitcoin and Ethereum) work
	2. Demonstrate blockchain network, smart contracts and distributed applications
	3. Integrate ideas from blockchain technology into their own projects
Course Outcomes	CO1: Understand and explore the working of Blockchain technology
	CO2: Interpret the concept of blockchain network
	CO3: Analyze mining process of crypto currency in learning with hyperledger
	CO4: Justify security, privacy, and efficiency of a given blockchain system.
	CO5: Investigate Blockchain applications in a structure manner.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	-	
CO2	-	-	-	3	3	-	-	-	-	-	-	-	3	-	
CO3	-	-	2	3	3	-	-	-	-	-	-	-	-	-	
CO4	-	2	-	-	2	-	-	-	-	-	-	-	-	-	
CO5	-	3	-	-	3	-	3	-	-	-	-	-	-	-	

Course Contents:

Unit	**Contents**	**Hours**
I	**Fundamentals of Blockchain:**tion to distributed computing, Introduction is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, types of Blockchain, Life of Blockchain application.	7
II	Blockchain Network: Advantage over conventional distributed database, P2P Systems, Blockchain Network, Distributed Consensus, Merkle Patricia Tree, Mining Mechanism, Reward, Transactional Blocks in blockchain, Anonymity, Chain Policy, Soft & Hard Fork, Private and Public blockchain.	7
III	BitCoin and Hyperledger: What is Bitcoin, Digital Currency, The Bitcoin Mining Process, Mining Developments, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, and Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger Fabric, Hyperledger Composer.	7
IV	Distributed Consensus & Cryptocurrency:	7

	Nakamoto consensus, Validation, Gas Limit, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate. Bitcoin protocols, Ethereum Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin	
V	Cryptocurrency Regulation & Applications: Stakeholders, Legal Aspects-Crypto currency Exchange Applications: Internet of Things, Medical Record Management System, Domain Name Service, Recent trends in Blockchain.	7

Text Books	1.	Block chain technology: concepts and applications, Kumar Saurabh, Ashutosh Saxena ,Wiley Publication edition (2020)
	2.	Blockchain Technology And Applications 1St Edition by Pethuru Raj, Kavita Saini , Taylor & Francis Ltd, September 2020.
E-Books	1.	BLOCKCHAIN ,Cybrosys Limited Edition, E-BOOK https://www.blockchainexpert.uk/book/blockchain-book.pdf
Reference Books	1	Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies. Mastering Blockchain - Imar Bashir - Second edition - Packt - 2018.
	2	DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
	3	Antonopoulos and G. Wood, Mastering Ethereum.
online TL Material	1.	Block chain technology: concepts and applications, Kumar Saurabh, Ashutosh Saxena ,Wiley Publication edition (2020)
	2.	Introduction to Blockchain Technology and Applications, Prof. Sandeep Shukla, IIT Kanpur https://nptel.ac.in/courses/106/104/106104220/

Sr. No	Name of Experiments / Mini Projects/ Case Studies	COs
1	A. Understanding Block using https://tools.superdatascience.com/Blockchain/block B. Understanding Blockchain using https://tools.superdatascience.com/Blockchain/Blockchain	CO1
2	A. Understanding Distributed Blockchain using https://tools.superdatascience.com/Blockchain/distributed B. Understanding Tokens using https://tools.superdatascience.com/Blockchain/tokens	CO1
3	To Design and Implement Transactional Blocks in a Blockchain Using C++ to Simulate Secure and Immutable Data Exchange	CO2
4	Write a program for building a Merkle Patricia Tree for Efficient Data Validation in Blockchain	CO2
5	Implement a simplified Bitcoin mining process using the Proof of Work (PoW) mechanism	CO3
6	Implement basic functionalities of asset creation, transactions, and ledger updates.	CO3
7	Implementing Proof of Work (PoW) and Difficulty Adjustment in a Cryptocurrency Blockchain Using C++	CO4
8	Implement gas limits for smart contract execution and resource optimization	CO4
9	Building a Blockchain-Based Ledger for Medical Records in Python. Task: To store and retrieve medical records securely using blockchain principles	CO5
10	Case Study: Blockchain Applications in Cryptocurrency Exchange and IoT Integration for Secure Transactions. Target: This case study focuses on the regulatory challenges, stakeholder roles, and practical implementation of blockchain-based solutions for cryptocurrency exchanges and IoT device management.	CO5
Open Ended Experiments / New Experiments		
1	Name of case based practical: Construction of a blockchain capable of handling transactions and executing smart contracts	

Programme Elective Core -3

Mapping of **Course Outcomes** with **Program Outcomes** and **Program Specific Outcomes**:

Course Title: **Agile Scrum Master**										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC3	4	NA	NA	4	10	15	50	NA	NA
Course Code	23BTCSL331									
Teaching Mode	Offline	4 Hrs			Total	75				
Duration of ESE	3 Hrs					75				
Course Objectives	1. Understand Scrum project management design, development, and deployment									
	2. Use Scrum project management tools, techniques, and skills									
	3. Align critical resources for effective Scrum project implementation									
Course Outcomes	After completion of the course student will be able to									
	CO1: Identify the core values and principles of Scrum.									
	CO2: Understand the difference between the defined process and Scrum, an empirical process.									
	CO3: Determine myths, user stories that are often attributed with a Scrum implementation									
	CO4: Analyse day-to-day role of a Scrum Master.									
	CO5: Evaluate, practice and Implement the entire Scrum framework.									

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO2	2	-	3	-	2	-	-	-	-	-	-	-	2	-	
CO3	2	2	2	2	3	-	-	-	-	-	-	3	-	3	
CO4	2	2	2	-	-	-	-	-	-	-	2	-	2	-	
CO5	2	-	3	-	-	-	2	-	2	-	-	2	-	3	

Course Contents:

Unit	Contents	Hours
I	Introduce Agile Principles & Scrum Overview: Introduce Agile Principles Lean Principles, Process control models ,Incremental and Iterative product development ,Shifting the focus on product management ,Overview of the Scrum process	9 Hrs
II	Project Strategies : Understand Dedicated cross functional teams , Conditions for Self-Organization , T-shaped people, Product backlog characteristics ,User Stories , Getting your first backlog	9 Hrs
III	Project Organization: Project Why comparative estimation works, Planning Poker, Getting backlog items Ready, Slicing User stories	8 Hrs
IV	Sprint Planning Project Sprint Planning Team capacity Facilitating the sprint planning meeting The Sprint backlog, Sprint Burndown chart, Scrum Meetings , Reviews Retrospectives	9 Hrs
V	Scrum Roles and Responsibilities: The Sprint, Definition of Done, How the team should work in a sprint, Tools for the ScrumMaster ,Sustainable Pace, Scrum Roles and Responsibilities , The Team and building effective teams , Scrum Master Responsibilities , Product Owner Responsibilities , The Scrum Project Community, What happens to traditional roles in Scrum. Certification course Safe Scrum Master and Agile Framework.	10 Hrs

Text Books	1.	Shore, David A., Launching and Leading Change Initiatives in Health Care Organizations: Managing Successful Projects. San Francisco: Jossey-Bass, 2014. ISBN 978-1-118-09914-8
	2.	Gregory Horine, PMP, Project Management Absolute Beginner's Guide, third edition, published in October 2012.
	3.	James P. Lewis, Fundamentals of Project Management, Published in 1995.
	4.	Chandanla Pataray, The Scrum Master Guidebook, Notion Press
On line TL Material	1.	Scrum Agile Framework https://www.tutorialspoint.com/scrum/scrum_tutorial.pdf
	2.	Agile Project Management for Dummies by Mark C. Layton, Steven J. Ostermiller, and Dean J. Kynaston https://www.coursera.org/articles/project-management-books
	3.	Project Management, Adrienne Watt https://open.umn.edu/opentextbooks/textbooks/456
Certification Courses		Certified SAFe Scrum Master (SSM) Courses https://www.udemy.com/topic/certified-safe-scrum-master-ssm/

Department of Computer Science and Engineering

Course Title: MOBILE COMPUTING										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC	4			4	10	15	50		
Course Code	23BTCSL332									
Teaching Mode	Offline	4Hrs.			Total	75				
Duration of ESE	3 Hrs.									

Course Objectives	1. To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
	2. To provide an opportunity for the students to understand the key components and technologies involved in building mobile applications.
	3. To understand latest network architecture and its interfaces.
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Understand the mobile computing architecture, foundation for mobile computing.
	CO2: Analyze GSM technologies, SMS concepts in mobile Computing
	C03: Explore the Services & application of GPRS
	CO4: Apply the concept of mobile IP network & Transport Layer.
	CO5: Understanding data Dissemination and data synchronization in mobile computing

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	-	-	3	3	2	3	2	2	3
CO2	3	3	2	2	2	2	-	-	3	3	2	3	2	2	3
CO3	3	3	2	2	2	2	-	-	3	3	2	3	2	2	3
CO4	3	2	2	2	2	1	-	-	3	3	2	3	2	2	3
CO5	3	2	2	2	2	1	-	-	3	3	2	3	2	2	3

Course Contents:

Unit	Contents	Hours
I	**Introduction**: Mobile Computing, Middleware and gateways, application and services, security in mobile computing. Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Mobile IP, Internet Protocol version 6(IPV6).	7
II	**GSM & GPRS:** Global Systems for Mobile Communication,(GSM) GSM Architecture, GSM Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Short Message Service (SMS): Mobile Computing over SMS, value added service through SMS, accessing the SMS bearer. General Packet Radio Service (GPRS):GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Limitations of GPRS, Billing and Charging in GPRS. Wireless Application Protocol (WAP): WAP, MMS, GPRS applications. CDMA (3G & 2G), GSM (3G & 2G), LTE (4G), 5G: spread spectrum technology, IS-95, CDMA versus GSM versus LTE, Wireless data, 3rd/4th/5th Generation Networks, applications of 3G/4G/5G.	9
III	**Mobility Support in IP and TCP:** Mobile IP – Mobile Agent, Foreign Agent, Care of Address, Registration, Advertisement and Discovery, Tunneling, IP within IP – Mobility Support in IPV6 – Mobility Header, Mobility Options, Dynamic Home Agent Address Discovery, Cache Management, Bidirectional Tunneling – TCP Over Wireless Networks –Indirect TCP -Snoop TCP – Mobile TCP.	8
IV	**Mobile IP Network and Transport Layer:** IP & Mobile IP Network Layers, Packet Delivery & Handover Management, Location Management, Registration, Tunneling & Encapsulation, Route Optimization, Dynamic Host Configuration Protocol, IPSec, Mobile Transport Layer, Conventional TCP/IP Transport Layer Protocol, Indirect TCP, Mobile Ad-hoc Networks(MANET), Routing and Routing Algorithms in MANET, security in ad-hoc networks.	8
V	**Data Dissemination and Synchronization:** Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization–Introduction, Software, and Protocols.	8

Text Books	1.	Ashok Talukder, Roopa Yavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.
	2.	Dr. Sunil kumar S. Manavi, Mahabaleshwar S. Kakkasageri, Wireless and Mobile Networks, concepts and protocols, Wiley, India.
E-Books	1.	http://www.e-booksdirectory.com/details.php?ebook=11901
	2.	https://doi.org/10.29085/9781856048996
Reference Books	1.	Martyn Mallik: Mobile and wireless design essentials, Wiley ,India,2003
	2.	Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi
	3.	Iti Saha Misra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.
On-line TL Material	1.	https://www.cet.edu.in/noticefiles/270_Lecture%20note%20@%20MC.pdf
	2.	https://mrcet.com/downloads/digital_notes/CSE/III%20Year/AIML/140224/Mobie%20Computing.pdf
	3.	https://www.skdavpolytech.ac.in/news_files/mc_1586805280.pdf
	4.	https://annamalaiuniversity.ac.in/studport/download/sci/cis/resources/MCA-Second%20Year-Mobile%20Computing-MCAC403.pdf

Department of Computer Science and Engineering

Course Title: **Distributed Computing**										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	PEC3	4 Hrs			4	10	15	50	-	-
Course Code	23BTCSL333									
Teaching Mode	Offline	4 Hrs			Total	75			-	
Duration of ESE	3 Hrs					75				

Course Objectives	1. To provide students with contemporary knowledge in distributed systems 2. To equip students with skills to analyze and design distributed applications. 3. To provide master skills to measure the performance of distributed synchronization algorithms
Course Outcomes	**CO1:** Understand of the basic elements and concepts related to distributed system technologies **CO2**: Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware. **CO3**: Analyze the various techniques used for clock synchronization and mutual exclusion **CO4**: Demonstrate the concepts of Resource and Process management and synchronization algorithms **CO5**: Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	--	--	--	--	2	--	--	--	--	--	--	2	--
CO2	1	3	3	--	--	--	--	--	--	--	--	--	3	--
CO3	1	--	3	3	--	--	--	--	--	--	--	--	--	3
CO4	2	--	--	--	3	--	--	--	--	--	--	--	2	--
CO5	--	2	--	--	2	3	--	--	--	--	--	--	2	--

Course Contents:

Unit	**Contents**	**Hours**
I	**Introduction to Distributed Systems :** Introduction and motivation to Distributed Systems, Characteristics, Applications, Challenges, Architecture types, Fundamental models, Inter-process and inter-node communication .	7
II	**Communication :** Layered Protocols, Inter process communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote	10

	Method Invocation (RMI), Message Oriented Communication, Stream Oriented Communication, Group Communication, Distributed File System Design and Implementation, Case Studies of NFS, Andrew File Systems, HDFS, Distributed Resource Management	
III	**Synchronization :** Clock Synchronization Techniques, Network Time Protocol, Logical Clocks, Vector Clocks, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure, Non Token based Algorithms: Lamport Algorithm, Causally Ordered Broadcast and Unicast, Termination Detection – Ring based and Dijkstra Scholten algorithms, Leader Election – Ring based, Franklin's algorithm and Bully Algorithm	10
IV	**Resource and Process Management :** Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach, Introduction to process management, process migration, Threads, Virtualization, Clients, Servers, Code Migration	8
V	**Distributed Deadlock Detection**: Resource and Communication Deadlocks – Centralized technique, Distributed technique - edge chasing and path pushing algorithms, Hierarchical technique, Recovery from Deadlocks, Fault Tolerance, Handling Crash faults –Two phase commit protocol, non-blocking three phase commit protocol, Birman-Joseph Atomic Broadcast Protocol, Voting techniques for fault tolerance.	10

Text Books	1.	Singhal and Shivratri, "Advanced concepts in Operating Systems", McGraw Hill
	2.	Coulouris, "Distributed Systems", AWL Press. Pearson Education
E-Books	1.	https://link.springer.com/book/10.1007/978-3-031-02012-4
Reference Books	1.	https://freecomputerbooks.com/Parallel-and-Distributed-Computing.html
	3.	A. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
	4.	M. L. Liu, ―Distributed Computing Principles and Applications‖, Pearson Addison Wesley, 2004
online TL Material	1.	https://www.youtube.com/watch?v=w8KFPWkK0bI&list=PLawkBQ15NDEkDJ5IyLIJUTZ1rRM9YQq6N

Multidisciplinary Minor-IV

Course Title: Introduction to Cloud Computing										
Semester	**VI**	**Teaching Scheme**				**Evaluation Scheme**				
						Theory			**Practical**	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	MDM4	2 Hrs			2	10	15	50	NA	NA
Course Code	23BTCSL308									
Teaching Mode	Offline	2 Hrs			Total	75				
Duration of ESE	3 Hrs					75				

Course Objectives	To understand Cloud Computing concepts, technologies, architecture and applications
	To understand the underlying principle of cloud virtualization, cloud storage, data management and data visualization
	To understand different cloud programming platforms and tools to develop and deploy applications on cloud
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Describe fundamental concepts of cloud computing and identify key services offered by popular cloud platforms.
	CO2: Apply cloud development techniques to configure virtual machines, build private cloud environments, and deploy scalable cloud-based applications.
	CO3: Analyze the suitability of different PaaS environments for specific cloud applications and evaluate their performance for enterprise use cases.
	CO4: Design and develop cloud-based solutions tailored to enterprise needs by leveraging best practices and cloud technologies.
	CO5: Critically evaluate various cloud programming models and create innovative solutions to address complex real-world challenges using cloud infrastructure.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	**Program Outcomes and Program Specific Outcomes**														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	3	2	--	--	--	2	--	--	--	--	--	3	--	
CO2	1	--	--	2	3	--	--	--	--	--	--	--	3	--	
CO3	--	--	3	--	--	--	--	--	--	--	--	--	3	--	
CO4	--	--	--	3	--	--	--	--	--	--	--	--	--	2	
CO5	--	--	--	--	3	--	--	--	--	--	--	--	--	2	

Course Contents:

Unit	Contents	Hours
I	**Introduction to Cloud Computing and Virtualization**: Virtualization Concepts, Cloud Computing Fundamental: Overview of Computing Paradigm, Evolution of cloud computing, Defining cloud computing, Components of a computing cloud, Essential Characteristics of Cloud Computing, Cloud Taxonomy. Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service (SaaS), Hardware-as-a-service: (HaaS), Oriented Architecture (SOA)	7
II	**Cloud Computing Architecture and Service Management in Cloud** Computing :Cloud architectural principles, Role of Web services, Benefits and challenges to Cloud architecture, Cloud Service Models, cloud computing vendors. Cloud Services, Management, Performance and scalability of services, tools and technologies used to manage cloud services deployment	8
III	**Data and Resource Management in Cloud Computing**: Data storage, migration, security, backup, and analytics, along with efficient resource allocation, auto-scaling, performance monitoring, cost optimization, and energy-efficient practices in cloud environments.	6
IV	**Cloud Security and Risk Management:** Cloud Security: Understanding cloud based security issues and threats, Data security and Storage, Identity& Access Management, Risk Management in cloud, Governance and Enterprise Risk Management.	7
V	**Open Source and Commercial Clouds:** Openstack, AWS, Google Cloud, Microsoft Azure, Cloud Simulator and IoT Cloud Framework, Research trend in Cloud Computing, Fog Computing,	7

Text Books	1.	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
	2.	Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
E-Books	1.	CLOUD COMPUTING Principles and Paradigms Link: http://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf
Reference Books	1.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
	2.	Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
online TL Material	1.	https://nptel.ac.in/courses/106/105/106105167/

Department of Computer Science and Engineering

Vocational and Skill Enhancement Elective –IV

Course Title: **Web Technology**										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	Even	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	VSEC4	1	--	2	2	10	15	--	25	--
Course Code	23BTCSL309 23BTCSP309									
Teaching Mode	Offline	3			Total	25			25	
						50				

Course Objectives	To understand the basic principles of web designing
	To learn web page creation using HTML
	To Visualize the basic concept of HTML
	To Introduce and understand the basic concept of CSS
	To learn dynamic website design using CSS
Course Outcomes	Upon successful completion of this course, student will be able to:
	CO1: Explain the basic principles of web designing
	CO2: Implement all basic tags in HTML
	CO3: Design web page using HTML
	CO4: Apply the basic concept of CSS.
	CO5: Apply CSS for designing of Box Model

Mapping of Course Outcomes with Program Outcomes & PSOs:

Course Outcomes	Program Outcomes														
	PO 1	PO2	PO	PO4	PO 5	PO	PO 7	PO 8	PO 9	PO	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	-	3	3	-	-	-	-	-	-	-	-	1	2	-	-
CO2	-	1	3	-	-	-	-	-	2	-	-	2	3	-	-
CO3	-	1	2	2	-	-	-	-	3	-	-	2	3	-	-
CO4	-	1	2	2	-	-	-	-	3	-	-	2	3	-	-
CO5	-	1	2	2	-	-	-	-	3	-	-	2	3	-	-

Course Content :

Unit	Contents	Hours
I	**Web Design Principles:** Basic principles involved in developing a website, Planning process, Five Golden rules of web designing, Designing navigation bar, Page design, Home Page Layout, Design Concept.	3
II	**Introduction to HTML:**What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags.	3
III	**Elements of HTML:**What is World Wide Web, Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.	3
IV	**Introduction to Cascading Style Sheets:** Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables.	3
V	**Cascading Style Sheets:**CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties).	3

Text Books	1.	HTML 5 in simple steps by Kogent Learning Solutions Inc. Dreamtech Press
	2.	HTML, XHTML, and CSS Bible, 5ed Steven M. Schafer , Wiley India
E-Books	1.	HTML 5 in simple steps by Kogent Learning Solutions Inc. Dreamtech Press
Reference Books	1.	Web Technologies: HTML, Javascript, Kogent Learning, Wiley India

Department of Computer Science and Engineering

List of Experiments:

<table>
<tr><th>Sr. No.</th><th>Name of Experiments</th><th>CO</th></tr>
<tr><td>1</td><td>Write an HTML page to print HELLO WORLD in bold and italic.</td><td>CO1</td></tr>
<tr><td>2</td><td>Write a program to create a profile page to display educational details, Hobbies, Achievements, Your Ideals, etc, using basic tags in HTML.</td><td>CO1</td></tr>
<tr><td>3</td><td>Write a program to implement HTML code for your own study timetable as shown below. (Hint: use the colspan and rowspan attributes).

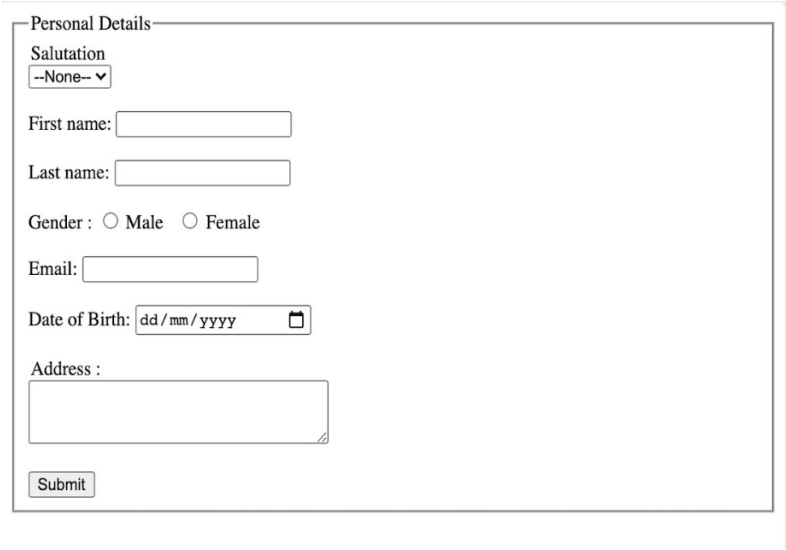
<table>
<tr><th colspan="6">Time Table</th></tr>
<tr><td rowspan="6">Hours</td><td>mon</td><td>tues</td><td>Wed</td><td>Thrus</td><td>Fri</td></tr>
<tr><td>Science</td><td>Maths</td><td>Science</td><td>Maths</td><td>Arts</td></tr>
<tr><td>Science</td><td>Maths</td><td>Science</td><td>Maths</td><td>Arts</td></tr>
<tr><td colspan="5">Lunch</td></tr>
<tr><td>Science</td><td>Maths</td><td>Science</td><td>Maths</td><td rowspan="2">Project</td></tr>
<tr><td>Science</td><td>Maths</td><td>Science</td><td>Maths</td></tr>
</table></td><td>CO2</td></tr>
<tr><td>4</td><td>Create a HTML page given below

Lists of Subjects

1. Computer Engineering Department
a. Web Development
b. Database Management System
c. Software Engineering

2. Electrical Engineering Department
• Electrical Machine
• Power Electronics
• Micro controllers

3. Computer Engineering
It is a discipline that integrate several fields required to develop computer system.</td><td>CO2</td></tr>
<tr><td>5</td><td>Write a program to implement a web page with one or multiple frames</td><td>CO3</td></tr>
</table>

6	Create a HTML Form given below. 	CO3
7	Create your own style sheets and use them in your web page.	CO4
8	Create a webpage using CSS Box Model.	CO4
9	Design a website using any open source tool.	CO4
10	Open Ended Practical.	CO4

Department of Computer Science and Engineering

Course Title: Research Methodology										
Semester	VI	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	EVEN	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	RM			4	2				50	
Course Code	23BTSHP302									
Teaching Mode	Offline	4 Hrs			Total	50				
Duration of ESE										

Name of Subject: Research Methodology	Semester: VI
COURSE OUTCOME	
CO1	Knowledge on various kinds of research questions and research designs
CO2	Formulate research problems (task) and develop a sufficiently coherent research design
CO3	Assess the appropriateness of different kinds of research designs
CO4	Knowledge on qualitative, quantitative and mixed methods of research, as well as relevant
CO5	Assess the Intellectual Property Rights related with research work

Sr.No.	Practical List	Mapping With CO
1	Select a problem from your area of interest, identifying the type of research problem it is and perform the SWOT analysis of the existing literature.	CO1
2	Generate research questions and hypotheses for a problem from your area of interest.	CO1
3	Identify the population and sample for the study (highlighting the technique used for sample selection) for a problem from your area of interest	CO2
4	Design a questionnaire for the problem of interest.	CO2
5	Compile a literature review on the chosen topic, highlighting key findings and gaps in existing research.	CO3
6	Based on the literature review, formulate hypotheses related to the chosen research problem.	CO3
7	Perform basic statistical analyses like measures of relationship, simple regression analysis, and multiple correlation and regression.	CO4
8	Develop a research report based on the conducted study, following the principles of writing and data analysis reporting.	CO4
9	Perform the process for filing a Patent.	CO5
10	Perform the process for filing a Copyright.	CO5

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Course Code	Name of Course	Course Category	Teaching Scheme				Credits	Evaluation Scheme					
								Theory			Practical		Total Marks
			L	T	P	Total Hours		TAE	CAE	ESE	INT	EXT	
SEMESTER-VII													
UITL422 UITP422 UITL421 UITP421	Elective-II: 1) Scripting Language 2) Wireless Adhoc Network	EL	3		2	5	4	10	15	50	25		100
UCSL452A UAIL313	Elective- III: 1) Digital Marketing 2) Blockchain Technology	EL	3			3	3	10	15	50			75
UCSL442 UAIL443	Elective – IV: 1) Business Intelligence Analytics 2) Digital Forensics	EL	3			3	3	10	15	50			75
UAIL324B UITL406	Elective – V: 1) AWS: Cloud Computing Services 2) Mobile Computing	EL	3			3	3	10	15	50			75
UITL461 UAIL442	Elective – VI: 1) Agile Scrum Master 2) Virtual & Augmented Reality	EL	3			3	3	10	15	50			75
UITP412	Project	P			8	8	4				50	50	100
			15		**10**	**25**	**20**	**50**	**75**	**250**	**75**	**50**	**500**

Department of Computer Science and Engineering

Course Title: **Scripting Language**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-II	3	-	2	4	10	15	50	25	-
Course Code	UITL401 UITP401									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs					100				

Course Outcomes	After completing this course, students will be able to
	CO1: Acquire programming skills in scripting language
	CO2: Develop web based application using suitable client side and server side web technologies.
	CO3: Enhance the concept & Develop the Application using Angular JS & Node JS
	CO4: Design & Develop the Web Based Application using Ruby
	CO5: Implement the web based Application Using Perl

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	-	3	-	-	-	3	1	3	2	3	1	1
CO2	3	2	3	-	3	-	-	-	2	1	2	2	3	3	3
CO3	3	3	2	1	3	-	-	-	1	1	1	2	3	2	2
CO4	3	2	3	2	3	-	-	-	1	1	1	2	3	3	3
CO5	3	1	3		3	-	-	-	1	1	1	2	3	3	3

Course Contents:

Unit	Contents	Hours
I	**INTRODUCTION TO PHP Database Language** PHP : Starting to script on server side, Arrays, function and forms, advance PHP Databases : Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables.	8
II	**Angular JS and Node JS :Angular JS :** dependency injection, custom directives, Internationalization. **Introduction to NodeJS and Struts:** Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.	8
III	**Server-Side Web Scripting** Rails, PHP, Zope, the JSP expression language; The evils of scriptlets; Scripting and the Seamantic Web.	8
IV	**Introduction to Ruby** :Introduction to Ruby, Rails, The structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Webservers, SOAP and webservices, RubyTk – Simple Tk Application, widgets, Binding events, Canvas, scrolling	8
V	**Introduction to PERL** Introduction to PERL, Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.	8

Books:

Text Books	1. Achyut Godbole & Atul Kahate, "Web Technologies: TCP/IP to Internet Application Architectures", McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
	2. Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13 : 9788126538676
	3. The World of Scripting Languages, David Barron,Wiley Publications.
	4. Ruby Progamming language by David Flanagan and Yukihiro Matsumoto O'Reilly
Reference Books	1. Robin Nixon, "Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3
	2. Web Technologies, Black Book, Dreamtech PressIan Dodson, The Art of Digital Marketing, Wiley Publications.
	3. Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J. Lee and B. Ware (Addison Wesley) Pearson Education.

List of Practicals:

Sr. No	Name of Experiments / Mini Projects/ Case Studies
1	Develop simple calculator for addition, subtraction, multiplication and division operation using JavaScript(Design & Develop a Web Based Application using Java Script)
2	Design and develop web application using PHP and MySQL as a back-end for Customer data with insert, Display operations.
3	Create an application for Bill Payment Record using AngularJS.
4	Create an application for Result Calculation and display in Proper Format using AngularJS.
5	Implement Node.js web-based application
6	Implement Node.js as a File Server for Read files, Create files, Update files, Delete files, Rename files
7	Count the frequency of base G in a given DNA sequence using perl.(Calculate: 1. How many hours are in a year. 2. How many minutes are in a decade? 3. How many seconds old are you? Using irb in ruby.)
8	Calculate: 1. How many hours are in a year. 2. How many minutes are in a decade? 3. How many seconds old are you? Using irb in ruby. (Count the frequency of base G in a given DNA sequence using perl)

Department of Computer Science and Engineering

Course Title: **Wireless Adhoc Network**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-II	3	-	2	4	10	15	50	25	-
Course Code	UITL409 UITP409									
Teaching Mode	Offline	5 Hrs			Total	75			25	
Duration of ESE	3 Hrs					100				

Course Outcomes	After completing this course, students will be able to
	CO1: Describe importance and use of Wireless Ad-hoc Networks
	CO2:Analysis the Issues involved in MAC Protocol
	CO3: Recognize importance of localization and routing techniques
	CO4: Explore the Design Goals & Classification involved in Transport Layer
	CO5: Understand importance of security in Wireless Ad-hoc Networks.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	2	2	2	-	2	3	3	3	3	3	2	3
CO2	3	3	3	2	3	2	-	-	3	2	2	2	3	2	2
CO3	3	3	3	2	3	2	-	-	3	2	1	2	3	2	2
CO4	3	2	3	2	3	2	-	-	3	2	1	2	3	2	2
CO5	3	3	3		3	2	-	-	2	2	1	2	3	2	1

Course Contents:

Unit	Contents	Hours
I	**Introduction:** Ad-hoc Wireless Networks Introduction, definition, characteristics, features, applications, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet, Adhoc Mobility Models- Indoor and outdoor models.	8
II	**MAC:** MAC Protocols for Ad hoc wireless Networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols, Contention based protocols with reservation mechanisms. Contention-based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols.	8
III	**Routing:** Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.	8
IV	**Transport Layer:** Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks	8
V	**Security :** Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, Network security attacks, Key management, Secure routing in Ad hoc wireless Networks.	8

List of Books:

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

Department of Computer Science and Engineering

List of Practicals:

Sr. No	Name of Experiments / Mini Projects/ Case Studies
1	Develop simple calculator for addition, subtraction, multiplication and division operation using JavaScript(Design & Develop a Web Based Application using Java Script)
2	Design and develop web application using PHP and MySQL as a back-end for Customer data with insert, Display operations.
3	Create an application for Bill Payment Record using AngularJS.
4	Create an application for Result Calculation and display in Proper Format using AngularJS.
5	Implement Node.js web-based application
6	Implement Node.js as a File Server for Read files, Create files, Update files, Delete files, Rename files
7	Count the frequency of base G in a given DNA sequence using perl.(Calculate: 1. How many hours are in a year. 2. How many minutes are in a decade? 3. How many seconds old are you? Using irb in ruby.)
8	Calculate: 1. How many hours are in a year. 2. How many minutes are in a decade? 3. How many seconds old are you? Using irb in ruby. (Count the frequency of base G in a given DNA sequence using perl)

Course Title: **Mobile Computing**										
Semester	VII	Teaching Scheme				Evaluation Scheme				
						Theory			Practical	
Term	ODD	Th	Tu	Pr	Credits	TAE	CAE	ESE	INT	EXT
Course Category	Elective-V	3	-	-	3	10	15	50	-	-
Course Code	UITL406									
Teaching Mode	Ofline	3			Total	75				
Duration of ESE	3 Hrs.					75				

Course Objectives	To introduce an advanced element of learning in the field of wireless communication.
	To learn about the concepts and principles of mobile computing.
	To understand concept of mobile adhoc network.
Course Outcomes	Recall the history of wireless communication, its applications and advantages over wired network
	Understand specialized medium access control for wireless network such as SDMA, FDMA, TDMA, CDMA.
	Observe technical requirement of GSM, its network structure and protocols.
	Identify network layer protocols, its applications, properties and various routing algorithms
	Elaborate wireless application protocols, its architecture, working of all protocol layers, along with Bluetooth, Wireless LAN and J2ME

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

Course Outcomes	Program Outcomes and Program Specific Outcomes													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3		3	2								2	2
CO2			3		3								2	
CO3			3	3	3								2	3
CO4			3		3								2	
CO5	3	3	3	3	3								2	3

Course Contents:

Unit	Contents	Hours
I	History of Wireless Communication, Applications of Wireless Communication, A simplified Reference Model, A second generation 2G services systems, radio link, channel types, antennas and its types. Advantages of Wireless Network over Wired Network	7
II	Introduction to Cellular system,(Wireless) Medium Access Control: Motivation for a specialized MAC Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Comparison of DMA/FDMA/TDMA/CDMA. Comparison of Mobile OS with Desktop OS.	7
III	Introduction to GSM system, GSM background, GSM operational and technical requirements. cell layout and frequency planning, mobile station, base station systems, switching sub systems, home locations register(HLR), Visiting Location Register (VLR), equipment identity register, echo canceller. GSM network structure, Protocols, Localization and calling, Handovers	8
IV	Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol (DHCP). TCP over Wireless Networks – Traditional TCP, Indirect TCP, Snooping TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP, routing and various routing algorithms, multicast routing, security in MANETs	7
V	Protocols and Tools: Wireless Application Protocol-WAP; Introduction,protocol architecture, and treatment of protocols of all layers; Bluetooth – User scenarios, physical layer, MAC layer, networking, security, link management; Wireless LAN and J2ME.	7

Text Books	1.	Ashok Talukder, Roopa Yavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.
	2.	Dr. Sunil kumar S. Manavi, Mahabaleshwar S. Kakkasageri, Wireless and Mobile Networks, concepts and protocols, Wiley, India.
E-Books	1.	http://www.e-booksdirectory.com/details.php?ebook=11901
	2.	https://doi.org/10.29085/9781856048996
Reference Books	1.	Martyn Mallik: Mobile and wireless design essentials, Wiley ,India,2003
	2.	Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi
	3.	Iti Saha Misra: Wireless Communications and Networks, 3G and Beyond, Tata McGrawHill,2009.
On-line TL Material	1.	https://www.cet.edu.in/noticefiles/270_Lecture%20note%20@%20MC.pdf
	2.	https://mrcet.com/downloads/digital_notes/CSE/III%20Year/AIML/140224/Mobie%20Computing.pdf
	3.	https://www.skdavpolytech.ac.in/news_files/mc_1586805280.pdf
	4.	https://annamalaiuniversity.ac.in/studport/download/sci/cis/resources/MCA-Second%20Year-Mobile%20Computing-MCAC403.pdf