SITE21 Regulations

COURSE STRUCTURE for B. Tech. (CST)

Semester I (First year I -I)

S.No	Subject Code	Course	Hours			Credits
			L	T	P	
1	21CMMAT1010	Engineering Mathematics- I	3	0	0	3
2	21CTPHT1020	Engineering Physics	3	0	0	3
3	21CMCHT1030	Engineering Chemistry	3	0	0	3
4	21CMCTT1040	Programming for Problem Solving	3	0	0	3
5	21CTMEL1050	Computer Aided Engineering Graphics	2	0	2	3
6	21CTPHL1060	Engineering Physics Lab	0	0	3	1.5
7	21CMCHL1070	Engineering Chemistry Lab	0	0	3	1.5
8	21CMCTL1080	Programming for Problem Solving Lab	0	0	3	1.5
9	21CMESN1090	Constitution of India, Professional Ethics & Human Rights	2	0	0	0
Total Credits						**19.5**

Semester II (First year I -II)

S.No	Subject Code	Course	Hours			Credits
			L	T	P	
1	21CMEGT2010	Technical English	3	0	0	3
2	21CMMAT2020	Engineering Mathematics - II	3	0	0	3
3	21CMEET2030	Basic Electrical Engineering	3	0	0	3
4	21CMCTT2040	Python Programming	3	0	0	3
5	21CTCTT2050	Data Structures	3	0	0	3
6	21CMEGL2060	English Communication Skills Lab	0	0	3	1.5
7	21CMEEL2070	Basic Electrical Engineering Lab	0	0	3	1.5
8	21CTCTL2080	Data Structures Lab	0	0	3	1.5
9	21CMMSN2090	Environmental Science	2	0	0	0
Total Credits						**19.5**

Semester III (Second year II-I)

S. No	Code	Course Title	Hours			Credits
			L	T	P	
1	21CMMAT3010	Probability Distributions & Statistical Methods	3	0	0	3
2	21CTECT3020	Analog & Digital Electronics	3	0	0	3
3	21CTCTT3030	Computer Organization	3	0	0	3
4	21CTCTT3040	Java Programming	3	0	0	3
5	21CTCTT3050	Data Base Management Systems	3	0	0	3
6	21CTCTL3060	Analog &Digital Electronics Lab	0	0	3	1.5
7	21CTCTL3070	Java Programming Lab	0	0	3	1.5
8	21CTCTL3080	Data Base Management Systems Lab	0	0	3	1.5
9	21CTCTS3090	Data Science Using Python	0	0	3	2
10	21CTMSN3100	Biology for Engineers	2	0	0	0
Total Credits						**21.5**

Semester IV (Second year II-II)

S.No	Code	Course Title	Hours			Credits
			L	T	P	
1	21CMMAT4010	Discrete Mathematics	3	0	0	3
2	21CTMST4020	Engineering Economics& Financial Management	3	0	0	3
3	21CTCTT4030	Operating systems	3	0	0	3
4	21 CTCTT4040	Design and Analysis of Algorithms	3	0	0	3
5	21 CTCTT4050	Software Engineering	3	0	0	3
6	21CTCTL4060	Operating systems Lab	0	0	3	1.5
7	21CTCTL4070	Design and Analysis of Algorithms Lab	0	0	3	1.5
8	21CTCTL4080	Software Engineering Lab	0	0	3	1.5
9	21CTCTS4090	MEAN Stack Technologies	2	0	0	2
Total Credits						**21.5**

Semester V (Third Year III-I)

S. No	Category	Code	Course Title	Hours			Credits
				L	T	P	
1	PC	21CTCTT5010	Automata Theory& Compiler Design	3	0	0	3
2	PC	21CTCTT5020	Computer Networks	3	0	0	3
3	PC	21CTCTT5030	Data Warehousing and Mining	3	0	0	3
4	PE-I	21CTCTP504X	Professional Elective -I	3	0	0	3
5	OE-I	21CTXXO505X	Open Elective - I	3	0	0	3
6	PC	21CTCTL5060	Computer Networks lab	0	0	3	1.5
7	PC	21CTCTL5070	Data Warehousing and Mining Lab	0	0	3	1.5
8	SOC	21CMAHS5080	**Skill Oriented Course** Soft Skills & Aptitude Builder - 1	1	0	2	2
9	MC	21CTCTN5090	Intellectual Property Rights	2	0	0	0
Summer Internship 2 Months (Mandatory) after second year (to be evaluated during V semester)				0	0	0	1.5
						Total credits	**21.5**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4

Category	Credits
Professional core Courses	12
Professional Elective courses	3
Open Elective Course	3
Skill oriented course	2
Summer Internship	1.5
Total Credits	**21.5**

Professional Elective - I	
Code	**Course Title**
21CTCTP504A	Software Testing
21CTCTP504B	Artificial Intelligence
21CTCTP504C	Distributed Systems
21CTCTP504D	Software Project Management

Semester VI (Third year III-II)

S. No	Category	Code	Course Title	Hours			Credits
				L	T	P	
1	PC	21CTCTT6010	Machine Learning	3	0	0	3
2	PC	21CTCTT6020	Devops	3	0	0	3
3	PC	21CTCTT6030	Unified Modelling Language	3	0	0	3
4	PE-I	21CTCTP604X	Professional Elective -II	3	0	0	3
5	OE-II	21CTXXO605X	Open Elective Course	3	0	0	3
6	PC	21CTCTL6060	Machine Learning Lab	0	0	3	1.5
7	PC	21CTCTL6070	Devops Lab	0	0	3	1.5
8	PC	21CTCTL6080	Unified Modelling Language Lab	0	0	3	1.5
9	SOC	21CMAHS6090	**Skill Oriented Course** Soft Skills & Aptitude Builder - 2	1	0	2	2
10	MC	21CTCTN6100	**Mandatory course** Essence of Indian Traditional Knowledge	2	0	0	0
Total credits							**21.5**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4

Category	Credits
Professional core courses	13.5
Professional Elective courses	3
Open Elective Course	3
Skill-oriented course/ soft skill course*	2
Mandatory course (AICTE)	0
Total Credits	**21.5**

Professional Elective - II	
Code	**Course Title**
21CTCTP604A	Software Quality Assurance
21CTCTP604B	Cyber Security
21CTCTP604C	Design Patterns
21CTCTP604D	Block-chain Technology

Semester VII (Fourth year IV-I)

S. No	Category	Code	Course Title	Hours			Credits
				L	T	P	
1	PE	21CTCTP701X	Professional Elective -III	3	0	0	3
2	PE	21CTCTP702X	Professional Elective - IV	3	0	0	3
3	PE	21CTCTP703X	Professional Elective - V	3	0	0	3
4	OE-III	21CTXXO704X	Open Elective Course	3	0	0	3
5	OE-IV	21CTXXO705X	Open Elective Course	3	0	0	3
6	HS	21CTMST7060	Management Science	0	0	3	3
7	SOC	21CTCTS7070	**Skill Oriented Course** ETL Spark	1	0	2	2
	Summer Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester)			0	0	0	3
						Total credits	**23**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4

Professional Elective - III	
Code	**Course Title**
21CTCTP701A	Big Data Analytics
21CTCTP701B	Network Programming
21CTCTP701C	Mobile Computing

Professional Elective - IV	
Code	**Course Title**
21CTCTP702A	Soft Computing
21CTCTP702B	Human Computer Interaction
21CTCTP702C	Computer Vision

Professional Elective - V	
Code	**Course Title**
21CTCTP703A	Deep Learning

21CTCTP703B	Data Visualization
21CTCTP703C	Wireless Network Security

Semester VIII (Fourth year IV-II)

S. No	Category	Code	Course Title	Hours			Credits
				L	T	P	
1	PR	21CTCTR8010	Project	0	0	12	12
						Total credits	**12**

AUTOMATATHEORY& COMPILER DESIGN			
Subject Code	21CTCTT5010	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: Introduction to Formal Languages, DFA, and NFA			**Hours**
Formal Languages and Regular Expressions: Languages, operations on languages, regular expressions (re), languages associated with (re), operations on (re), Identity rules for (re), Finite Automata: DFA, NFA, Conversion of a regular expression to NFA, NFA to DFA.			**10**
Unit -2: Context Free Grammars & Introduction to Compilers			
Context Free Grammars and parsing: Context free Grammars, Leftmost Derivations, Rightmost Derivations, Parse Trees, Ambiguity Grammars, Phases of compiler, Applications of Finite Automata to lexical analysis.			**10**
Unit – 3: Parsers			
Top-Down Parsing, Recursive Descent Parsers: LL(1)Parsers. Bottom-up Parsers: Shift Reduce Parser, LR Parsers: SLR, CLR, LALR			**10**
Unit – 4: Intermediate Code Generation & Code Optimization			
Intermediate code generation: Three address codes, abstract syntax tree, translation of simple statements, and control flow statements. **Code Optimization:** Issues in the design of code optimization, Principal sources of optimization, optimization of basic blocks, Loop optimization, peephole optimization			**10**
Unit – 5: Code Generation			
Code Generation: Issues in the design of code Generation, Machine Dependent Code Generation, object code forms, Register allocation and assignment, DAG representation of basic Blocks, Generating code from DAGs			**08**

Text(T) / Reference(R) Books:	
T1	A Text Book on Automata Theory, Nasir S.F.B, P.K.Srimani, Cambridge university Press
T2	Introduction to Automata Theory,Formal languages and computation, Shamalendukandar, Pearson
T3	Compilers Principles, techniques and Tools, Aho, Ullman, RaviSethi, PEA
R1	Introduction to theory of computation, 2nd ed, Michelsipser, CENGAGE
R2	Principles of Compiler Design, A.V. Aho. J.D.Ullman;PEA
R3	Theory of Computer Science, Automata languages and computation, 2/e, Mishra, Chandra Shekaran, PHI
R4	Theory of Computation, a problem solving approach, kaviMahesh,Wiley
W1	https://onlinecourses.nptel.ac.in/noc18_cs14/preview

Course Outcomes:	
CO1	Ability to classify machines by their power to recognize languages.
CO2	Design context free grammars for formal languages
CO3	Ability to describe the different types of parsers. i.e. Top-down, Bottom-up parsers, Construction of SLR, CLR and LALR parse table
CO4	Ability to explain code optimization techniques
CO5	Ability to explain code generation techniques to improve the performance of a program in terms of speed &space.

COMPUTER NETWORKS			
Subject Code	21CTCTT5020	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: Introduction			**Hours**
Network Topologies, WAN, LAN, MAN. OSI Reference Model, TCP/IP Reference Model, Multiplexing (Frequency Division, Wavelength Division, Synchronous Time Division and Statistical Time Division Multiplexing Techniques), Switching Techniques (Circuit-switching, Datagram, Virtual Circuit Networks).			**10**
Unit -2: The Data Link Layer			
Design Issues, Services Provided to the Network Layer, Framing, Error Control, Flow Control, Error Detection and Correction, Error Correcting Codes, Error Detecting Codes, A Simplex Stop and Wait Protocol for an Error free channel, A Simplex Stop and Wait Protocol for a Noisy Channel, Sliding Window Protocols (A One Bit Sliding Window Protocol-A Protocol Using Go-Back-NA Protocol Using Selective Repeat), Data Link Layer in HDLC: Configuration and transmission modes, frames, control fields.			**10**
Unit – 3: The Medium Access Control Sub layer			
The Channel Allocation Problem, Static Channel Allocation, Assumptions for Dynamic Channel Allocation, Multiple Access Protocols (Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited Contention Protocols, Wireless LAN Protocols).			**10**
Unit – 4: Routing Algorithms			
Routing Algorithms- Shortest-Path Routing, Flooding, Hierarchical routing, Broadcast, Multicast and Distance Vector Routing. Congestion Control Algorithms, Approaches to Congestion Control-Traffic Aware Routing-Admission Control-Traffic Throttling-Load Shedding, IP Addressing, Classless and Class full Addressing, Sub-netting.			**10**
Unit – 5: Application Layer			
Application Layer: The Domain Name System- The DNS Name Space, Resource Records, Name Servers, Electronic Mail Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery.			08

Text(T) / Reference(R) Books:	
T1	Computer Networks, 5th Edition, Tanenbaum and David J Wetherall, Pearson Edu, 2010.
T2	Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education.
R1	Computer Networks, Mayank Dave, CENGAGE
R2	Data and Computer Communications, Fifth Edition, William Stallings, PHI, 2005.
R3	Computer Networks, A Systems Approach, Fifth Edition, Peterson & Davie, Harcourt, 2011.
R4	Network Management Standards, Second Edition, Ulysses Black, McGraw Hill, 1994
W1	https://swayam.gov.in/courses/5172-computer-networks
W2	https://www.coursera.org/courses?query=computer%20network

Course Outcomes:	
CO1	Illustrate the concept of network reference models and classification of multiplexing.
CO2	Explain the design issues and various protocols of data link layer.
CO3	Interpret the use of medium access control sub layer.
CO4	Analyze various routing algorithms.
CO5	Experiment with congestion control algorithms and to illustrate the concept of domain name system.

DATA WAREHOUSING & MINING			
Subject Code	21CTCTT5030	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: Introduction			**Hours**
Data Warehousing and Business Analysis: - Data warehousing OLAP & OLTP Components –Building a Data warehouse –Data Warehouse Architecture. Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.			**10**
Unit -2: Data Pre-processing			
Data Pre-processing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization			**10**
Unit – 3: Classification			
Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, methods for expressing an attribute test conditions, measures for selecting the best split, Algorithm for decision tree induction. Bayes' Theorem, Naïve Bayesian Classification, Bayesian Belief Networks			**10**
Unit – 4: Association Analysis			
Problem Defecation, Frequent Item Set generation, Rule generation, compact representation of frequent item sets, FP-Growth Algorithm.			**10**
Unit – 5: Cluster Analysis			
What Is Cluster Analysis? Different Types of Clustering, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bisecting K-means, Strengths and Weaknesses; Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Centre-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses.			**08**

Text(T) / Reference(R) Books:	
T1	Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson.
T2	Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier
R1	Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
R2	Data Mining: Vikram Pudi and P. Radha Krishna, Oxford.
R3	Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki, Wagner Meira, Jr, Oxford
R4	Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.
R5	Data Mining: Introductory and Advanced Topics: Dunham, Pearson.
W1	https://www.edx.org/learn/data-mining
W2	https://www.coursera.org/specializations/data-mining
W3	https://www.coursera.org/courses?query=data%20warehouse

Course Outcomes: On completion of this course, students can	
CO1	Understand stages in building a Data Warehouse
CO2	Understand the need and importance of pre-processing techniques
CO3	Understand the need and importance of Similarity and dissimilarity techniques
CO4	Analyze and evaluate performance of algorithms for Association Rules.
CO5	Analyze Classification and Clustering algorithms

SOFTWARE TESTING (PROFESSIONAL ELECTIVE-I)			
Subject Code	21CTCTP504A	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1			**Hours**
Introduction: Purpose of Testing, Dichotomies, Model for Testing, Levels of Testing, Basic definitions, Software Testing Principles, The Tester‘s Role in a Software Development, Consequences of Bugs, Taxonomy of Bugs. **Flow graphs and Path testing:** Basics Concepts of Path Testing, Predicates, Path Predicates and Achievable Paths, Path Sensitizing, Path Instrumentation, Applications of Path Testing.			**10**
Unit -2			
Transaction Flow Testing: Transaction Flows, Transaction Flow Testing Techniques. **Dataflow testing:** Basics of Data flow Testing, Strategies in Data flow Testing, Application of Data flow Testing			**08**
Unit – 3			
Paths and Regular expressions: Path Expression, Reduction Procedure, Applications, Regular Expressions & Flow Anomaly Detection. **Syntax Testing:** Grammar for formats, Test Case Generation, Implementation and Application and Testability Tips			**10**
Unit – 4			
Logic Based Testing: Overview, Decision Tables, KV Charts, and Specifications **State, State Graphs and Transition Testing:** State Graphs, Good & Bad State Graphs, State Testing, and Testability Tips. **Graph Matrices and Application: -** Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm.			**10**
Unit – 5			
Software Testing Tools: Introduction to Testing, Automated Testing, Concepts of Test Automation, skills needed for automation, scope of automation, challenges in automation, Introduction to testing tools like Win runner, Load Runner, Selenium and working with selenium			**08**

Text(T) / Reference(R) Books:	
T1	"Software testing techniques"–BorisBeizer, Dreamtech, second edition.
T2	"Software Testing"- Yogesh Singh, Camebridge
R1	"The Craft of software testing" - Brian Marick, Pearson Education.
R2	"Software Testing", N.Chauhan, Oxford University Press.
R3	"Introduction to Software Testing", P.Ammann &J.Offutt, Cambridge Univ.Press.
R4	"Effective methods of Software Testing", Perry, John Wiley, 2nd Edition, 1999.
R5	"Foundations of Software Testing", D.Graham, CengageLearning
W1	https://www.coursera.org/courses?query=software%20testing
W2	https://www.edx.org/course/software-testing-fundamentals-usmx-umuc-stv1-1x-4

Course Outcomes:	
CO1	Discuss basic software testing terminology, concepts of path testing and applications.
CO2	Discuss Data flow testing and transaction flow testing methods
CO3	Implement and generate test cases in syntax testing
CO4	Develop test cases and test suites by using different testing methods
CO5	Analyze the applications manually by applying different testing methods in state graphs and transition testing

ARTIFICIAL INTELLIGENCE (PROFESSIONAL ELECTIVE-I)			
Subject Code	21CTCTP504B	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. To provide a strong foundation of fundamental concepts in Artificial Intelligence.
2. To provide a basic exposition to the goals and methods of Artificial Intelligence.
3. To apply the techniques in applications which involve perception, reasoning and learning.

Unit -1: Introduction to Artificial Intelligence	**Hours**
What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.	**10**
Unit -2: Problem solving	
Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions.	**10**
Unit – 3: Knowledge Representation	
Knowledge-Based Agents, Logic, Propositional Logic: A Very Simple Logic, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, The Internet Shopping World	**10**
Unit – 4: Uncertain Knowledge and Reasoning	
Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks.	**10**
Unit – 5: AI present and Future	
Weak AI: Can Machines Act Intelligently? Strong AI: Can Machines Really Think?, The Ethics and Risks of Developing Artificial Intelligence, Agent Components, Agent Architectures, Are We Going in the Right Direction?, What If AI Does Succeed?.	**08**

Text(T) / Reference(R) Books:	
T1	Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach” , 3rd Edition, Pearson.
T2	Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill
R1	SarojKaushik, “Artificial Intelligence”, Cengage Learning India, 2011
R2	David Poole and Alan Mackworth, “Artificial Intelligence: Foundations for Computational Agents”, Cambridge University Press 2010.
R3	Trivedi, M.C., “A Classical Approach to Artifical Intelligence”, Khanna Publishing House, Delhi.
W1	https://nptel.ac.in/courses/106105077 https://nptel.ac.in/courses/10610612
W2	https://aima.cs.berkeley.edu https://ai.berkeley,edu/project_overview.htm

Course Outcomes: On completion of this course, students can	
CO1	To introduce basic concepts of AI with its working principles.
CO2	To understand different kinds of heuristic search algorithms to get feasible solutions for AI problems.
CO3	To understand problem reduction concepts using various problem reduction techniques. (Ex: Problem reduction using AO* algorithm, Towers of Hanoi problem, Matrix Multiplication problem)
CO4	To understand various Knowledge Representation (KR) techniques
CO5	To understand different kinds of Expert Systems.

DISTRIBUTED SYSTEMS (PROFESSIONAL ELECTIVE – I)			
Subject Code	21CTCTP504C	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Unit -1: Introduction to Distributed Systems	**Hours**
Distributed Systems: Definition, Relation to computer system components, Motivation, Relation to parallel systems, Message-passing systems versus shared memory systems, Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges. **A model of distributed computations:** A distributed program, A model of distributed executions, Models of communication networks, Global state, Cuts, Past and future cones of an event, Models of process communications. Logical Time: A framework for a system of logical clocks, Scalar time, Vector time, Physical clock. synchronization: NTP.	**10**
Unit -2: Message Ordering & Snapshots	
Message ordering and group communication: Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order. Global state and snapshot recording algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels.	**10**
Unit – 3: Distributed Mutex& Deadlock	
Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport‘s algorithm – Ricart-Agrawala algorithm – Maekawa‘s algorithm – Suzuki–Kasami‘s broadcast algorithm. Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp‘s classification – Algorithms for the single resource model, the AND model and the OR model.	**08**
Unit – 4: Recovery & Consensus	
Check pointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated check pointing algorithm – Algorithm for asynchronous check pointing and recovery. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure – free system – Agreement in synchronous systems with failures.	**10**
Unit – 5: Peer-to-peer computing and overlay graphs	
Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. **Distributed shared memory**: Abstraction and advantages – Memory consistency models –Shared memory Mutual Exclusion.	**10**

Text(T) / Reference(R) Books:	
T1	“Distributed Systems” by Andrew S. Tanenbaum and Maarten van Steen , Fourth Edition, 2023.
T2	“Designing Data-Intensive Applications” by Martin Kleppmann, Second Edition 2020.
R1	Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall of India, 2007.
R2	Distributed Systems: Principles and Paradigms, Tanenbaum A.S., Van Steen M.,Pearson Education, 2007.
W1	https://nptel.ac.in/courses/106/106/106106168/

Course Outcomes:	
CO1	Elucidate the foundations and issues of distributed systems
CO2	Illustrate the various synchronization issues and global state for distributed systems
CO3	Illustrate the Mutual Exclusion and Deadlock detection algorithms in distributed systems
CO4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems
CO5	Describe the features of peer-to-peer and distributed shared memory systems

SOFTWARE PROJECT MANAGEMENT (PROFESSIONAL ELECTIVE - I)			
Subject Code	21CTCTP504D	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: Introduction			**Hours**
Project, Management, Software Project Management activities, Challenges in software projects, stake holders, objectives & goals. Project Planning: Step-wise planning, Project scope, Project products & deliverables, Project activities, Effort estimation, Infrastructure. Project Approach: Life cycle models, choosing technology, prototyping, life cycle phases, process artefacts, process work flows.			**10**
Unit -2: Effort estimation & Activity Planning			
Estimation techniques, Function point analysis, SLOC, COCOMO, Usecase-based estimation, Activity identification approaches, network planning models, critical path analysis.			**10**
Unit – 3: Risk management			
Risk categories, Identification, Assessment, Planning and management, PERT technique, Monte Carlo approach.			**10**
Unit – 4: Project Management and Control			
Creating framework for monitoring and control, progress monitoring, Cost monitoring, Earned value analysis, defects tracking, issues tracking, status reports, Types of resources, Identifying resource requirements, Resource scheduling.			**10**
Unit – 5: Software Quality			
Planning quality, defining quality – ISO 9016, Quality measures, quantitative quality management planning, product quality & process quality metrics, statistical process control capability maturity model, enhancing software quality.			**08**

Text(T) / Reference(R) Books:	
T1	Software Project Management, Bob Hughes & Mike Cotterell, TATA McGraw-Hill
T2	Software Project Management, Walker Royce: Pearson Education, 2005
T3	Software Project Management in practice, Pankaj Jalote, Pearson
R1	Software Project Management, Joel Henry, Pearson Education

Text(T) / Reference(R) Books:	
T1	Software Project Management, Bob Hughes & Mike Cotterell, TATA McGraw-Hill
T2	Software Project Management, Walker Royce: Pearson Education, 2005
T3	Software Project Management in practice, Pankaj Jalote, Pearson
R1	Software Project Management, Joel Henry, Pearson Education

Computer Networks Lab			
Subject Code	21CTCTL5060	IA Marks	15
Number of Tutorial Hours/Week	03(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

Exercise1

Understanding and using of commands like ifconfig, netstat, ping, arp, telnet, ftp, finger, traceroute, whoisetc. Usage of elementary socket system calls (socket (), bind(), listen(), accept(),connect(),send(),recv(),sendto(),recvfrom().

Exercise2

Implementation of Connection oriented concurrent service (TCP).

Exercise3

Implementation of Connectionless Iterative time service (UDP).

Exercise4

Implementation of Select system call.

Exercise5

Implementation of gesockopt (), setsockopt () system calls.

Exercise6

Implementation of getpeername () system call.

Exercise7

Implementation of remote command execution using socket system calls.

Exercise8

Implementation of Distance Vector Routing Algorithm.

Exercise9

Implementation of SMTP.

Exercise10

Implementation of FTP.

Exercise11

Implementation of HTTP.

Exercise12

Implementation of RSA algorithm**.**

DATA WAREHOUSING AND MINING LAB			
Subject Code	21CTCTL5070	IA Marks	15
Number of Tutorial Hours/Week	03(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

Note: Use python library scikit-learn wherever necessary

Exercise1

Demonstrate the following data preprocessing tasks using python libraries.

a) Loading the dataset

b) Identifying the dependent and independent variables c) Dealing with missing data

Exercise2

Demonstrate the following data preprocessing tasks using python libraries.

a) Dealing with categorical data

b) Scaling the features

c) Splitting dataset into Training and Testing Sets

Exercise3

Demonstrate the following Similarity and Dissimilarity Measures using python

a) Pearson's Correlation

b) Cosine Similarity

c) Jaccard Similarity

d) Euclidean Distance

e) Manhattan Distance

Exercise4

Build a model using linear regression algorithm on any dataset.

Exercise5

Build a classification model using Decision Tree algorithm on iris dataset

Exercise6

Apply Naïve Bayes Classification algorithm on any dataset

Exercise7

Generate frequent itemset using Apriori Algorithm in python and also generate association rules for any market basket data.

Exercise 8

Apply K- Means clustering algorithm on any dataset.

Exercise9

Apply Hierarchical Clustering algorithm on any dataset.

Exercise10

Apply DBSCAN clustering algorithm on any dataset.

Course Outcomes:	
CO1	Apply preprocessing techniques on real world datasets
CO2	Apply apriori algorithm to generate frequent itemsets.
CO3	Apply Classification algorithms on different datasets.
CO4	Apply Clustering algorithms on different datasets.
CO5	Find dissimilarities in data

Soft Skills & Aptitude Builder - 1			
Subject Code	21CMAHS5080	IA Marks	**15+15**
Number of Lecture Hours/Week	**2**	Exam Marks	**35+35**
Total Number of Lecture Hours	**32**	Exam Hours	**3**
Credits – 2			
Section A, Soft Skills			
Unit – 1: Intrapersonal Communication			**Hours**
Introduction to Soft Skills and its Significance **Personal Effectiveness**: Who am I and What am I; My Strengths and Weaknesses; SWOT Analysis; SMART Goal Setting; Being Proactive **Principles of Personal Vision**: Beginning with the End in Mind; Time Management: Understanding Priorities; Put First-Things-First **Activity**: Psychometric Tests and SWOT Analysis, SMART Goal Setting			**6**
Unit 2: Interpersonal Communication			
Principles of Creative Cooperation and Organisation Skills: Think Win-Win; Seek First to Understand then to be Understood; Synergize; Life-Long Learning **Emotional Intelligence**: Self-Awareness, Self-Regulation, Empathy, Assertiveness, Adoptability, Managing Emotions **Activity**: Resolving a Conflict with your Friend/Colleague/Family Member; Group Discussions & Debates			**6**
Unit – 3: 21st Century Skills			
What are 21st Century Skills? Learning Skills- Digital Literacy- Life Skills **Critical Thinking**: Active Listening, Observation, Introspection, Analytical Thinking, Open Mindedness **Problem Solving**: Understanding the Complexity of the Problem, Defining the Problem, Cause and Effect Analysis, Exploring Possible Solutions, Planning Actions, Analysing Results of your Actions, Getting Feedback, Redefining the Problem, The Problem Solving Cycle **Decision Making**: Managing Conflict, Conflict Resolution, Methods of Decision Making, Effective Decision Making in Teams – Methods & Styles **Activity**: Case Study			**6**
Section B,Aptitude Builder			
Unit – 4: Ratios & Percentages			
Definition of Ratio, Properties of Ratios, Comparison of Ratios, Problems on Ratios, Compound Ratio, Problems on Proportion, Mean Proportional and Continued Proportion. **Partnership:** Introduction, Relation between Capitals, Period of Investments and Shares **Number System:** Classification of Numbers, Divisibility Rules, Finding the Units Digit, Finding Remainders in Divisions Involving Higher Powers, LCM and HCF Models **Percentages:** Introduction, Converting a Percentage into Decimals, Converting a Decimal into Percentage, Percentage Equivalent of Fractions, Problems on Percentages **Profit And Loss:** Problems on Profit and Loss Percentage, Relation between Cost Price and Selling Price, Discount and Marked Price, Two Different			**7**

Articles Sold at Same Cost Price, Two Different Articles Sold at Same Selling Price Gain% / Loss% on Selling Price **Problems on Ages:** Introduction, Problems based on Ages **Averages:** Definition of Average, Rules of Average, Problems on Average , Problems on Weighted Average, Finding Average using Assumed Mean Method **Alligation and Mixture:** Problems on Mixtures, Alligation Rule, Problems on Alligation	
Unit – 5: Mental Ability	
Difference Series, Product Series, Squares Series, Cubes Series, Alternate Series Combination Series, Miscellaneous Series, Place Values of Letters **Number and Letter Analogies:** Definition of Analogy, Problems on Number Analogy, Problems on Letter Analogy, Problems on Verbal Analogy **Odd Man Out:** Problems on Number Odd Man Out, Problems on Letter Odd Man Out, Problems on Verbal Odd Man Out **Coding and Decoding:** Coding using Same Set of Letter, Coding using Different Set of Letters, Coding into a Number, Problems on R-Model **Blood relations:** Defining the Various Relations among the Members of a Family, Solving Blood Relation Puzzles, Solving the Problems on Blood Relations using Symbols and Notations **Direction Sense:** Solving Problems by Drawing the Paths, Finding the Net Distance Travelled, Finding the Direction, Problems on Clocks ,Problems on Shadows	**7**

Section-A: Text (T) / Reference (R) Books:	
For Units 1, 2, & 3	
T1	English and Soft Skills, Dr. S. P. Dhanvel, Orient Blackswan, 2011
R1	Seven Habits of Highly Effective People, Stephen R Covey
R2	Emotional Intelligence, Daniel Goleman, Bantom Book, 2006
R3	21st Century Skills: Learning for Life in our Times, Bernie Trilling, Charles Fadel; John Wiley & Sons
For Units 4&5	
T1	R S Agarwal, S Chand, 'Quantitative Aptitude'
T2	R S Agarwal, S.Chand , 'A Modern Approach to Logical Reasoning'
R1	Quantitative Aptitude for CAT By Arun Sharma
R2	GL Barrons, Mc Graw Hills, Thorpe's Verbal Reasoning, LSAT Materials
Course Outcomes: On completion of this course, students can	
Section A: Soft Skills	
CO1	re-engineer attitude and understand its influence on behaviour
CO 2	develop interpersonal skills and be an effective goal oriented team player
CO 3	develop holistic personality with a mature outlook to function effectively in different circumstances
Section B: Aptitude Builder	
CO 4	solve the real-time problems for performing job functions easily
CO 5	analyse the problems logically and critically

INTELLECTUAL PROPERTY RIGHTS			
Subject Code	21CSCSN5090	IA Marks	30
Number of Lecture Hours/Week	2	Exam Marks	70
Total Number of Lecture Hours	30	Exam Hours	03
Credits – 00			
Unit -1:			**Hours**
Introduction: Introduction to Intellectual property, types of intellectual property, the importance of intellectual property rights, agencies Responsible for Intellectual property Registration, Regulatory – Compliance and Liability Issues.			06
Unit -2:			
Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, Transfer of Rights, protectable matter, selecting and evaluating trade mark, Registrations of Trade Marks, Claims. **Trade Secrets**: Determination of trade secret status, liability for misappropriations of trade secrets, protection for submission,			**06**
Unit – 3:			
Copy rights: Fundamental of copy right, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, notice of copy right. **Patents:** introduction, patent searching process, ownership rights and transfer			**06**
Unit – 4:			
Cyber Law – Information Technology Act – Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy – International aspects of Computer and Online Crime.			**06**
Unit – 5:			
New development of Intellectual Property: Emerging trends in trade mark; copy rights, patent, International overview on intellectual property.			**06**

Text(T) / Reference(R) Books:	
T1	Intellectual property right, Deborah, E. Bouchoux, cengage learning.
T2	Cyber Law. Text & Cases, South-Western's Special Topics collections
T3	R. Radha Krishnan, S. Balasubramanian: "Intellectual Property Rights", Excel Books. New Delhi
R1	A short course in International Intellectual Property Rights – Karla C. Shippey, World Trade Press – 2 nd Edition
R2	Intellectual Property Rights: N K Acharya: ISBN: 9381849309

Course Outcomes:	
CO1	IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.
CO2	Apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems and analyze the social impact of intellectual property law and policy
CO3	Student gets an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.
CO4	Students should be able to write reports on project work and critical reflect on their own learning.
CO5	Analyze ethical and professional issues which arise in the intellectual property law context

Semester VI (Third year III-II)

S. No	Category	Code	Course Title	Hours			Credits
				L	T	P	
1	PC	21CTCTT6010	Machine Learning	3	0	0	3
2	PC	21CTCTT6020	Devops	3	0	0	3
3	PC	21CTCTT6030	Unified Modelling Language	3	0	0	3
4	PE-I	21CTCTP604X	Professional Elective -II	3	0	0	3
5	OE-I	21CTXXO605X	Open Elective Course	3	0	0	3
6	PC	21CTCTL6060	Machine Learning Lab	0	0	3	1.5
7	PC	21CTCTL6070	Devops Lab	0	0	3	1.5
	PC	21CTCTL6080	Unified Modelling Language Lab	0	0	3	1.5
8	SOC	21CTCTS6090	**Skill Oriented Course** Soft Skills & Aptitude Builder - 2	1	0	2	2
9	MC	21CTCTN6100	**Mandatory course** Essence of Indian Traditional Knowledge	2	0	0	0
Total credits							**21.5**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4

Category	Credits
Professional core courses	13.5
Professional Elective courses	3
Open Elective Course	3
Skill-oriented course/ soft skill course*	2
Mandatory course (AICTE)	0
Total Credits	**21.5**

Professional Elective - II	
Code	**Course Title**
21CTCTP604A	Software Quality Assurance
21CTCTP604B	Cyber Security
21CTCTP604C	Design Patterns
21CTCTP604D	Block-chain Technology

MACHINE LEARNING			
Subject Code	21CTCTT6010	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1. Familiarity with a set of well-known supervised, unsupervised and semi-supervised learning algorithms.
2. The ability to implement some basic machine learning algorithms.
3. Understanding of how machine learning algorithms are evaluated.

Unit -1: Introduction	**Hours**
Artificial Intelligence, Machine Learning, Deep learning, Types of Machine Learning Systems, Main Challenges of Machine Learning. **Statistical Learning:** Introduction, Supervised and Unsupervised Learning, Training and Test Loss, Tradeoffs in Statistical Learning, Estimating Risk Statistics, Sampling distribution of an estimator, Empirical Risk Minimization.	**10**
Unit -2: Supervised Learning (Regression/Classification)	
Basic Methods: Distance based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, Linear Models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Binary Classification: Multiclass/Structured outputs, MNIST, Ranking.	**10**
Unit – 3: Ensemble Learning and Random Forests	
Introduction, Voting Classifiers, Bagging and Pasting,Random Forests, Boosting, Stacking. **Support Vector Machine:** Linear SVM Classification, Nonlinear SVM Classification SVM Regression, Naïve Bayes Classifiers.	**10**
Unit – 4: Unsupervised Learning Techniques	
Clustering, K-Means, Limits of K-Means, Using Clustering for Image Segmentation, Using Clustering for Preprocessing, Using Clustering for SemiSupervised Learning, DBSCAN, Gaussian Mixtures. Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Using Scikit-Learn, Randomized PCA, Kernel PCA.	**10**
Unit – 5: Neural Networks and Deep Learning	
Introduction to Artificial Neural Networks with Keras, Implementing MLPs with Keras, Installing TensorFlow 2, Loading and Preprocessing Data with TensorFlow.	**08**

Text(T) / Reference® Books:	
T1	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019
T2	Data Science and Machine Learning Mathematical and Statistical Methods,Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman,25th November 2020
R1	Understanding Machine Learning: From Theory to algorithms, Shai Shalev-Shwartz, Shai Ben-David, Cambridge.
R2	Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012
W1	https://www.tutorialspoint.com/what-is-machine-learning
W2	https://www.analyticsvidhya.com/machine-learning/
W3	https://www.youtube.com/watch?v=eq7KF7JTinU

Course Outcomes: On completion of this course, students can	
CO1	Explain the fundamental usage of the concept Machine Learning system
CO2	Demonstrate on various regression Technique
CO3	Analyze the Ensemble Learning Methods
CO4	Illustrate the Clustering Techniques and Dimensionality Reduction Models in Machine Learning.
CO5	Discuss the Neural Network Models and Fundamentals concepts of Deep Learning

DEVOPS			
Subject Code	21CTCTT6020	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Introduces the basic concepts of Information System.
2. To understand The Management Control Framework and The Application Control Framework

Unit -1: Introduction	**Hours**
Phases of Software Development Life Cycle, Values and principles of agile software development.	**10**
Unit -2: Fundamentals of DevOps	
Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system.	**10**
Unit - 3: DevOps adoption in projects	
Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes	**10**
Unit - 4: CI/CD	
Introduction to Continuous Integration, Continuous Delivery and Deployment, Benefits of CI/CD, Metrics to track CICD practices	**10**
Unit - 5: Devops Maturity Model	
Key factors of DevOps maturity model, stages of Devops maturity model, DevOps maturity Assessment	**08**

Text(T) / Reference® Books:	
T1	The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim , John Willis , Patrick Debois , Jez Humb,1st Edition, O'Reilly publications, 2016.
T2	What is Devops? Infrastructure as code, 1st Edition, Mike Loukides ,O'Reilly publications, 2012.
R1	Building a DevOps Culture, 1st Edition, Mandi Walls, O'Reilly publications, 2013

Course Outcomes: On completion of this course, students can	
CO1	Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility.
CO2	Describe DevOps & DevSecOps methodologies and their key concepts
CO3	Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
CO4	Set up complete private infrastructure using version control systems and CI/CD tools
CO5	Acquire the knowledge of maturity model, Maturity Assessment

UNIFIED MODELING LANGUAGE			
Subject Code	21CTCTT6030	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Understand how to solve complex problems and
2. Analyze the problems using the object-oriented approach
3. Design Solutions to the problems using an object-oriented approach
4. Study the notations of the unified modeling language

Unit – 1: Introduction	**Hours**
Introduction to OOAD, Activities/ Workflows / Disciplines in OOAD, Introduction to iterative development and the unified process, Introduction to UML, Mapping Disciplines to UML artefacts, why we model, Conceptual model of UML, Architecture, Classes, Relationships, Common Mechanisms, Class diagrams, Object diagrams.	**10**
Unit – 2: Classes and Objects	
Nature of object, Relationships among objects, Nature of a Class, Relationship among Classes, Interplay of Classes and Objects, Identifying Classes and Objects, Importance of Proper Classification, Identifying Classes and Objects, Key abstractions and Mechanisms.	**10**
Unit – 3: Basic Behavioral Modelling	
Interactions, Interaction diagrams, Use cases, Use case Diagrams, Activity Diagrams.	**10**
Unit – 4: Advanced Behavioral Modelling	
Events and signals, state machines, processes and Threads, time and space, state chart diagrams.	**10**
Unit – 5: Architectural Modelling	
Component, Deployment, Component diagrams and Deployment diagrams. *Case Study:* The Unified Library application.	**08**

Text(T) / Reference® Books:	
T1	Object- Oriented Analysis and Design with Applications, Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston, 3rd edition, 2013, PEARSON.
T2	The Unified Modeling Language User Guide, Grady Booch, James Rumbaugh, Ivar Jacobson, 12th Impression, 2012, PEARSON.
T3	Applying UML and Patterns by Criag Larman, Person
R1	Object-oriented analysis and design using UML, Mahesh P. Matha, PHI.
R2	Head first object-oriented analysis and design, Brett D. McLaughlin, Gary Pollice, Dave West, O‟Reilly.
R3	Object-oriented analysis and design with the Unified process John W. Satzinger, Robert B. Jackson, Stephen D. Burd, Cengage Learning.
R4	The Unified modelling language Reference manual, James Rumbaugh, Ivar Jacobson, Grady Booch, Addison-Wesley.
W1	https://www.coursera.org/courses?query=uml
W2	https://www.udemy.com/topic/uml/

Course Outcomes: On completion of this course, students can	
CO1	Ability to find solutions to the complex problems using object-oriented approach.
CO2	Represent classes, responsibilities and states using UML notation.
CO3	Identify Classes of problem domain.
CO4	Identify the responsibilities of the problem domain.
CO5	Learn Architectural modelling concepts

SOFTWARE QUALITY ASSURANCE (PROFESSIONAL ELECTIVE – II)			
Subject Code	21CTCTP604A	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: FUNDAMENTALS OF SOFTWARE QUALITY ASSURANCE			**Hours**
The Role of SQA, SQA Plan, SQA considerations, SQA people, Quality, Management, Software Configuration Management.			**10**
Unit -2: MANAGING SOFTWARE QUALITY			
Managing Software Organizations, Managing Software Quality, Defect Prevention, Software Quality Assurance Management.			**10**
Unit – 3: SOFTWARE QUALITY ASSURANCE METRICS			
Software Quality, Total Quality Management (TQM), Quality Metrics, Software Quality Metrics Analysis.			**08**
Unit – 4: SOFTWARE QUALITY PROGRAM			
Software Quality Program Concepts, Establishment of a Software Quality Program, Software Quality Assurance Planning, An Overview, Purpose & Scope.			**10**
Unit – 5: SOFTWARE QUALITY ASSURANCE STANDARDIZATION			
Software Standards–ISO 9000 Quality System Standards, Capability Maturity Model and the Role of SQA in Software Development Maturity, SEI CMM Level 5, Comparison of ISO 9000 Model with SEI's CMM.			**10**

Text(T) / Reference(R) Books:	
T1	Software Quality, Mordechai Ben-Menachem / Garry S Marliss, Vikas Publishing House, Pvt, Ltd., New Delhi.
T2	Managing the Software Process, Watts S Humphrey, Pearson Education Inc.
R1	Handbook of Software Quality Assurance, Gordon G Schulmeyer, Third Edition, Artech House Publishers 2007
R2	Software Quality Assurance: Principles and Practice, Nina S Godbole, Alpha Science International, Ltd, 2004
W1	https://www.udemy.com/software-quality-assurance/
W2	https://www.coursera.org/courses?query=quality%20assurance

Course Outcomes: On completion of this course, students can	
CO1	To learn Software quality factors
CO2	To learn Common software testing methodologies
CO3	To learn about project process control
CO4	To learn about software metrics and standardizations
CO5	To learn about certifications

CYBER SECURITY

(PROFESSIONAL ELECTIVE – II)

Subject Code	21CTCTP604B	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course Objectives:

The learning objectives of this course are:

1. The Cyber Security Course will provide the students with foundational Cyber Security principles, Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies.

2. Students will gain insight into the importance of Cyber Security and the integral role of Cyber Security professionals.

Unit -1: Introduction to Cybercrime	**Hours**
Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? , Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens	10
Unit -2: Cyber offenses	
How Criminals Plan Them –Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cyber Cafe, and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector Cloud Computing. *Cybercrime Mobile and Wireless Devices:* Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, *Mobile Devices:* Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.	**10**
Unit – 3: Tools and Methods Used in Cybercrime	
Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, *Phishing, and Identity Theft:* Introduction, Phishing, Identity Theft (IDTheft)	**10**
Unit – 4: Cybercrimes and Cybersecurity	
Why Do We Need Cyber laws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Information Security Planning and Governance, Information Security Policy Standards, Practices, The information Security	**10**

Blueprint, Security education, Training and awareness program, Continuing Strategies?	
Unit – 5: Understanding Computer Forensics	
Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Ant forensics	**08**

Text(T) / Reference(R) Books:	
T1	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole, Sunit Belapure, Wiley.
T2	Principles of Information Security, Micheal E.Whitman and Herbert J.Mattord, Cengage Learning.
R1	Information Security, Mark Rhodes, Ousley, MGH.
W1	https://www.edx.org/learn/cybersecurity
W2	https://www.cyberdegrees.org/resources/free-online-courses/

Course Outcomes: On completion of this course, students can	
CO1	Cyber Security architecture principles
CO2	Identifying System and application security threats and vulnerabilities
CO3	Identifying different classes of attacks
CO4	Cyber Security incidents to apply appropriate response
CO5	Describing risk management processes and practices, Evaluation of decision-making outcomes of Cyber Security scenarios

DESIGN PATTERNS (PROFESSIONAL ELECTIVE – II)			
Subject Code	21CTCTP604C	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Understand the various design patterns and choose design pattern for their problem.
2. Study and design creational design patterns for solving various software design problems.
3. Study and Construct Structural design patterns for real world reoccurring software problems.
4. Study and build behavioral design patterns for real world reoccurring software problems.
5. To construct design pattern for an application Document Editor.

Unit -1: Introduction	**Hours**
What Is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalogue of Design Patterns, Organizing the Catalogue.	**10**
Unit -2: Usage of Design patterns	
How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.	**10**
Unit – 3: Creational Patterns	
Abstract Factory, Builder, Factory Method, Prototype, Singleton.	**08**
Unit – 4: Structural Pattern	
Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.	**10**
Unit – 5: Behavioral Patterns	
Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer.	**10**

Text(T) / Reference(R) Books:	
T1	Design Patterns by Erich Gamma, Pearson Education.
R1	Satzinger: Object Oriented Analysis and Design, CENGAGE.
W1	https://www.javatpoint.com/design-patterns-in-java
W2	https://www.udemy.com/topic/design-pattern/

Course Outcomes: On completion of this course, students can	
CO1	Able to understand the software industries design practices through design patterns.
CO2	Identify the appropriate design patterns to solve object oriented design problems.
CO3	Develop the appropriate Creational Design Patterns solution to the real world software design problems.
CO4	Ability to identify and implement the appropriate Structural Design Patterns for the real world software design problem.
CO5	Choose and Construct the appropriate Behavioral Design Pattern for the real world software design problem.

BLOCK-CHAIN TECHNOLOGY			
Subject Code	21CTCTP604D	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. To assess blockchain applications in a structured manner.
2. To impart knowledge in blockchain techniques and able to present the concepts clearly and structured.
3. To get familiarity with future currencies and to create own crypto token.

Unit -1: Introduction	**Hours**
Overview of Blockchain, public ledgers, bitcoin, smart contracts, block in a blockchain, transactions, distributed consensus, public vs private blockchain, understanding cryptocurrency to blockchain, permissioned model of blockchain, overview of security aspects of blockchain, cryptographic hash function, properties of a hash function, hash pointer and Merkle tree, digital signature, public key cryptography, a basic cryptocurrency.	**10**
Unit -2: Understanding blockchain with cryptocurrency	
Creation of coins, payments and double spending, bitcoin scripts, bitcoin P2P network, transaction in bitcoin network, block mining, block propagation and block relay, distributed consensus in open environments, consensus in a bitcoin network, Proof of Work (PoW)- Basic Introduction, hashcashPoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of burn and proof of elapsed time, the life of a bitcoin miner, Mining- Difficulty, mining pool.	**10**
Unit – 3: Permissioned BlockChain	
Permissioned model and usecases, design issues for permissioned blockchains, execute contracts, state machine replication, overview of consensus models for permissioned block chain, Distributed consensus in closed environment, paxos, RAFT consensus, Byzantine general problem, Byzantine fault tolerance system, Lamport-Shostak-Pease BFT algorithm, BFT over Asynchronous systems.	**10**
Unit – 4: Enterprise application of Blockchain	
Cross border payments, Know Your Customer, Food security, Mortgage over blockchain, Blockchain enabled trade, trade finance network, supply chain financing, identity on blockchain.	**08**
Unit – 5: Blockchain application development	
Hyperledger fabric- architecture, identities and policies, membership and access control, channels, transaction validation, writing smart contract using Hyperledger fabric, writing smart contract using Ethereum, overview of Ripple and Corda.	**10**

Text(T) / Reference(R) Books:

T1	Block Chain: Blueprint for a new economy, Melanie Swan, O'Reilly, 2015.
T2	Block Chain: The Block Chain for Beginners- Guide to Block Chain Technology and Leveraging Block Chain Programming, Josh Thompsons
R1	Block Chain Basics, Daniel Drescher, Apress; 1st edition, 2017
R2	Block Chain and Crypto Currencies, Anshul Kaushik, Khanna Publishing House, Delhi.
R3	Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, Imran Bhashir, Packt Publishing.
W1	https://www.edx.org/learn/blockchain
W2	https://www.coursera.org/courses?query=blockchain

Course Outcomes: On completion of this course, students can	
CO1	Understand block chain technology.
CO2	Develop block chain-based solutions
CO3	Write smart contract using Hyperledger Fabric and Ethereum frameworks.
CO4	Build and deploy block chain application for on premise and cloud-based architecture.
CO5	Integrate ideas from various domains and implement them.

Machine Learning Lab			
Subject Code	21CTCTL6060	IA Marks	15
Number of Tutorial Hours/Week	03(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

Requirements: Develop the following program using Anaconda/ Jupiter/ Spider and evaluate ML models.

Experiment-1:

Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

Experiment-2:

For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

Experiment-3:

Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Experiment-4:

Exercises to solve the real-world problems using the following machine learning methods:

a) Linear Regression

b) Logistic Regression

c) Binary Classifier

Experiment-5:

Develop a program for Bias, Variance, Remove duplicates, Cross Validation

Experiment-6:

Write a program to implement Categorical Encoding, One-hot Encoding

Experiment-7:

Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Experiment-8:

Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

Experiment-9:

Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course Outcomes (Cos): At the end of the course, student will be able to

- Implement procedures for the machine learning algorithms
- Design and Develop Python programs for various Learning algorithms
- Apply appropriate data sets to the Machine Learning algorithms
- Develop Machine Learning algorithms to solve real world problems

DEVOPS LAB			
Subject Code	21CTCTL6070	IA Marks	15
Number of Tutorial Hours/Week	03(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

1. Write code for a simple user registration form for an event.

2. Explore Git and GitHub commands.

3. Practice Source code management on GitHub. Experiment with the source code written in exercise 1.

4. Jenkins installation and setup, explore the environment.

5. Demonstrate continuous integration and development using Jenkins.

6. Explore Docker commands for content management.

7. Develop a simple containerized application using Docker.

8. Integrate Kubernetes and Docker

9. Automate the process of running containerized application developed in exercise 7 using Kubernetes.

10. Install and Explore Selenium for automated testing.

11. Write a simple program in JavaScript and perform testing using Selenium.

12. Develop test cases for the above containerized application using selenium.

Unified Modelling Language Lab			
Subject Code	21CTCTL6080	IA Marks	15
Number of Tutorial Hours/Week	03(P)	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

List of Experiments

OBJECTIVES:

- To capture the requirements specification for an intended software system
- To draw the UML diagrams for the given specification
- To map the design properly to code
- To test the software system thoroughly for all scenarios
- To improve the design by applying appropriate design patterns.

Draw standard UML diagrams using an UML modeling tool for a given case study and map design to code and implement a 3 layered architecture. Test the developed code and validate whether the SRS is satisfied.

1. Identify a software system that needs to be developed.

2. Document the Software Requirements Specification (SRS) for the identified system.

3. Identify use cases and develop the Use Case model.

4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.

5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams

6. Draw relevant State Chart and Activity Diagrams for the same system.

7. Implement the system as per the detailed design

8. Test the software system for all the scenarios identified as per the usecase diagram

9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.

10. Implement the modified system and test it for various scenarios

SUGGESTED DOMAINS FOR MINI-PROJECT:

1. Passport automation system.

2. Book bank

3. Exam registration

4. Stock maintenance system.

5. Online course reservation system
6. Airline/Railway reservation system
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system

Soft Skills & Aptitude Builder - 2			
Subject Code	21CMAHS6090	IA Marks	15+15
Number of Lecture Hours/Week	2	Exam Marks	35+35
Total Number of Lecture Hours	32	Exam Hours	3
Credits - 2			
Section A, Soft Skills			
Unit – 1: Communicative Competence			**Hours**
Verbal Reasoning: Reading Comprehension-Text Completion- Sentence Equivalence Spotting Errors, Sequencing of Sentences, Parallelism in Structure E-Mail Etiquette, Reporting News Activity: Completing Exercises			**6**
Unit 2: Career and Employability Skills			
What is a Career: Career vs Job, Career Values & Grid, Skills vs Strengths, Spotting Skills/Reflection of Present Skills, Meeting the Expectation of your Employer, Matching your Skills with the Required Skills, Preparing Resume, Preparing for Interviews & Structuring Answers Activity: Resume Building, Interviews			**6**
Section B, Aptitude Builder			
Unit – 3: Time and Work			
Pipes and Cisterns: Problems on Unitary method, Relation between Men, Days, Hours and Work, Problems on Man-Day-Hours Method, Problems on Alternate Days, Problems on Pipes and Cisterns. **Time, Distance and Speed, Problems on Trains, Boats and Streams:** Relation between Speed, Distance and Time, Converting km/h into m/s and vice versa , Problems on Average Speed, Problems on Relative Speed, Problems on Circular Tracks, Problems on Races **Problems on Trains:** Two Trains Moving in Opposite Direction, Two Trains Moving in same Direction, A Train Crossing a Stationary Object of a Given Length like a Platform or Bridge, A Train Crossing a Stationary Object like a Pole or a Man **Boats and Streams:** Time Based, which can be considered as a Point Object Speed Based, Distance Based, Average Speed Based			**6**
Unit – 4: Logical and Analytical Reasoning			
Seating Arrangement: Linear Arrangement, Circular Arrangement, Tabler, Triangular Arrangement, Complex Arrangement**.** **Clocks :** Finding the Angle When the Time is Given, Finding the Time When the Angle is Known, Relation between Angles, Minutes and Hours, Position of Hands of the Clock, Time Gained or Lost by the Clock, Mirror /Water Image-based Time. **Calendars :** Definition of a Leap Year, Finding the Number of Odd Days, Framing the Year Code for Centuries, Finding the Day of any Random Calendar Date **Syllogisms:** Finding the Conclusions using Venn Diagram Method, Finding the Conclusions using Syllogism Method **Simple Interest:** Definitions, Problems on Interest and Amount, Problems when Rate of Interest and Time Period are Numerically Equal **Compound Interest:** Definition and Formula for Amount in Compound Interest, Difference between Simple Interest and Compound Interest for 2 Years on the Same Principle and Time Period.			**7**

Unit – 5: Permutations, Probability, Areas and Volumes	
Definition of permutation, Problems on Permutations, Definition of Combinations, problems on Combinations **Probability:** Definition of Probability, Problems on Coins, Problems on Dice, Problems on Deck of Cards, Problems on Years **Mensuration - 2D:** Formulas for Areas, Formulas for Volumes of Different Solids, Problems on Areas **Mensuration - 3D:** Problems on Volumes, Problems on Surface Areas	**7**

Text (T) / Reference (R) Books:	
For Units 1 & 2	
T1	Enhance Your Employability Skills, David Winter and Laura Brammar, University of London
T2	R.S. Agarwal, Verbal & Non-Verbal Reasoning, S. Chand & Co., Latest ed. 2003
R2	How to Prepare for Verbal Ability and Reading Comprehension, Arun Sharma, Meenakshi Upadhay, Mc Graw Hill
For Units 3, 4, & 5	
T1	R S Agarwal, S Chand, 'Quantitative Aptitude'
T2	R S Agarwal, S.Chand , 'A modern approach to Logical reasoning'
R1	Quantitative Aptitude for CAT By Arun sharma
R2	GL Barrons, Mc Graw Hills, Thorpe's verbal reasoning, LSAT Materials
Course Outcomes: On completion of this course, students can	
Section A: Soft Skills	
CO 1	learn and practice effective communication skills
CO 2	develop broad career plans, evaluate the employment market, and become industry ready
Section B: Aptitude Builder	
CO 3	develop accuracy on time and distance and units related solutions
CO 4	solve the real-time problems for performing job functions easily
CO 5	solve problems related to permutations and combinations, probability, areas and volumes

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Subject Code	21CTCTN6100	IA Marks	30
Number of Lecture Hours/Week	2	Exam Marks	70
Total Number of Lecture Hours	30	Exam Hours	03

Credits– 03

Course Objectives:

1. The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
2. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
3. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system

Unit -1: Introduction to Traditional Knowledge	**Hours**
Define Traditional Knowledge- Nature and Characteristics- Scope and Importance-kinds of Traditional Knowledge- The historical impact of social change on Traditional Knowledge Systems- Value of Traditional knowledge in global economy.	**06**
Unit-2: Basic structure of Indian Knowledge System	
AstadashVidya- 4 Ved - 4 Upaved (Ayurved, Dhanurved, GandharvaVed & SthapthyaAdi), 6 vedanga (Shisha, Kalppa, Nirukha, Vykaran, Jyothisha & Chand),4 upanga(Dharmashastra, Meemamsa, purana & Tharka Shastra).	**06**
Unit–3: Modern Science and Indian Knowledge System	
Indigenous Knowledge, Characteristics- Yoga and Holistic Health care-case studies.	**06**
Unit–4: Protection of Traditional Knowledge	
The need for protecting traditional knowledge - Significance of Traditional knowledge Protection-Role of government to harness Traditional Knowledge	**06**
Unit–5: Impact of Traditions	
Philosophical Tradition (Sarvadarshan) Nyaya, Vyshepec, Sankhya, Yog, Meemamsa, Vedantha, Chavanka, Jain &Boudh - Indian Artistic Tradition - Chitrakala, Moorthikala, Vasthukala , Sthapthya, Sangeetha, NruthyaYevamSahithya	**06**

Text(T) / Reference(R) Books:	
T1	Traditional Knowledge System in India, by Amit Jha, 2009.
T2	Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, PratibhaPrakashan 2012.
T3	Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, BharatiyaVidya
R1	Swami Jitatmanand, Holistic Science and Vedant, BharatiyaVidyaBhavan
R2	Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
	Web Links: 1.https://www.youtube.com/watch?v=LZP1StpYEPM 2.http://nptel.ac.in/courses/121106003/ 3.https://www.wipo.int/edocs/mdocs/tk/en/wipo_grtkf_ic_21/wipo_grtkf_ic_21_ref_facilitators_text.pdf

Course Outcomes: On completion of this course, students can	
CO1	Identify the concept of Traditional knowledge and its importance.
CO2	Classify the Indian Traditional Knowledge
CO3	Compare Modern Science with Indian Traditional Knowledge system.
CO4	Analyze the role of Government in protecting the Traditional Knowledge
CO5	Understand the impact of Philosophical tradition on Indian Knowledge System.

Semester VII (Fourth year IV-I)

S. No	Category	Code	Course Title	Hours			Credits
				L	T	P	
1	PE	21CTCTT701X	Professional Elective -III	3	0	0	3
2	PE	21CTCTT702X	Professional Elective - IV	3	0	0	3
3	PE	21CTCTT703X	Professional Elective - V	3	0	0	3
4	OE	21CTCTP704X	Open Elective Course	3	0	0	3
5	OE	21CTXXO705X	Open Elective Course	3	0	0	3
6	HS	21CTMST7060	Management Science	0	0	3	3
7	SOC	21CTCTS7070	**Skill Oriented Course** ETL Spark	0	0	3	2
	Summer Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester)			0	0	0	3
						Total credits	**23**
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4

Professional Elective - III	
Code	**Course Title**
21CTCTP701A	Big Data Analytics
21CTCTP701B	Network Programming
21CTCTP701C	Mobile Computing

Professional Elective - IV	
Code	**Course Title**
21CTCTP702A	Soft Computing
21CTCTP702B	Human Computer Interaction
21CTCTP702C	Computer Vision

Professional Elective - V	
Code	**Course Title**
21CTCTP703A	Deep Learning
21CTCTP703B	Data Visualization
21CTCTP703C	Wireless Network Security

BIG DATA ANALYTICS			
Subject Code	21CTCTP701A	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Unit -1: Introduction to Big Data	**Hours**
Big Data and its importance, Characteristics, Big data analytics, Basic requirements, Big data applications, Map Reduce framework, Algorithms using map reduce. *NoSQL Databases:* Key-value databases, Column-family databases, Document databases, Graph databases	10
Unit -2: Apache Hadoop	
Introduction, System principle, Architecture, Hadoop distributed file system, Hadoop Map Reduce, YARN, Operation modes, Hadoop Installation, Cluster creation, Hadoop commands, HDFS commands, YARN commands, Map Reduce commands, Moving Data in and out of Hadoop, Hadoop programming.	**10**
Unit – 3: Hadoop Ecosystem	
Introduction to Pig, Installation, Execution, Pig Latin: Basics, Data types, Building blocks, Operators, Functions, Example Scripts. Introduction to Hive: Installing and Running Hive, Hive QL, Tables, Querying data, User defined functions, Partitioning, Joins, Simple projects. Overview of Spark: Zookeeper, and other Hadoop Ecosystem tools.	**10**
Unit – 4: Data Analysis Techniques	
Linear and logistic regression modelling, Naive Baye's classifier, Support vector machine, Neural networks, Principal component analysis, Linear Discriminant Analysis, K Nearest Neighbor, Decision Trees, Fuzzy logic, Clustering Techniques : Hierarchical, agglomerative, and K– Means.	**10**
Unit – 5: Classification and regression	
Case Studies: Social network analysis, Text analysis, Marketing analysis.	**08**

Text(T) / Reference(R) Books:	
T1	Understanding Big data, Chris Eaton, Dirk deroos et al, McGraw Hill, 2012
T2	Hadoop: The Definitive Guide, Tom White, 3rd Edition, O'reilly, 2012

T3	Beginning R - The Statistical Programming Language, Mark Gardener, John Wiley & Sons, Inc., 2012
R1	Professional Hadoop Solutions, Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, Wiley, 2015
R2	Principles of Data Mining, David Hand, Heiki Mannila, Padhria Smyth, PHI 2013
R3	Big Data AnalytiCT: Disruptive Technologies for Changing the Game, Arvind Sathi, 1st Edition, IBM Corporation, 2012.
R4	An Introduction to R, W. N. Venables, D. M. Smith and the R Core Team,
R5	Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, Cambridge University Press, 2014.
R6	Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufmann Publishers, Third Edition, 2010.
W1	https://www.coursera.org/browse/data-science/data-analysis
W2	https://www.edx.org/learn/data-analysis

Course Outcomes: On completion of this course, students can	
CO1	Categorize and summarize big data and its importance
CO2	Differentiate various big data technologies like Hadoop, MapReduce.
CO3	Differentiate various big data technologies like Hadoop Ecosystem, R, and No-SQL
CO4	Apply tools and techniques to analyze big data
CO5	Earn tips and tricks for big data use cases and solutions.

NETWORK PROGRAMMING			
Subject Code	21CTCTP701B	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Unit -1: Introduction to Network Programming	**Hours**
Introduction to Network Programming: OSI model, UNIX standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application Elementary Sockets: Sockets introduction, Elementary TCP sockets.	**10**
Unit -2: TCP client server	
TCP client server: Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host.I/O Multiplexing: I/O Models, the select and poll functions, Batch input and buffering, shutdown function.	**08**
Unit - 3: Mobile Transport Layer	
UDP and Socket options: Elementary UDP sockets: Introduction UDP Echo server functions, lost datagram, summary of UDP example, Lack of flow control with UDP.Socketoptions:getsockopt and setsockopt functions. Socket states, Generic socket options IPV4 socket options, IPV6 socket options, ICMPV6 socket options and TCP socket options, SCTP socket options, fcntl function.	**10**
Unit - 4: Advanced Sockets and Daemon Processes	
Advanced Sockets and Daemon Processes: IPV4 and IPV6 interoperability, introduction, IPV4 client: IPV6 server, IPV6 client: IPV4 Server, IPV6 Address-testing macros. Daemon Processes and inetdSuperserver –Introduction, syslogd Daemon, syslog Function, daemon_init Function, inetd Daemon, daemon_inetd. Advanced I/O functions: Socket timeouts, recv and send functions, ready and writev functions, recvmsg and send msg functions, Ancillary data.	**10**
Unit - 5: Broadcasting and Multicasting	
Broadcasting and Multicasting: Broadcasting introduction, broadcast addresses, unicast versus Broadcast, dg_cli function using broadcasting, race conditions, Multicasting addresses, multicasting versus broadcasting on a LAN, multicasting on a WAN, source-specific multicast, multcast socket options. Raw Sockets: Introduction, Raw Socket Creation, Raw Socket Output, Raw Socket Input, Ping Program, Traceroute Program	**10**

Text(T) / Reference(R) Books:	
T1	UNIX Network Programming, by W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Pearson Education
T2	UNIX Network Programming, 1st Edition, W. Richard Stevens. PHI.
R1	UNIX Systems Programming using C++ T CHAN, PHI.
R2	UNIX for Programmers and Users, 3rd Edition Graham GLASS, King abls, Pearson Education
R3	Advanced UNIX Programming 2nd Edition M. J. ROCHKIND, Pearson Education
W1	https://onlinecourses.nptel.ac.in/noc16_CT13/preview

Course Outcomes: On completion of this course, students can	
CO1	To think and develop new mobile application.
CO2	To take any new technical issue related to this new paradigm and come up with a solution(s).
CO3	To develop new ad hoc network applications and/or algorithms/protocols.
CO4	To understand & develop any existing mobile time environment.
CO5	To understand & develop new protocol related to mobile time environment.

MOBILE COMPUTING			
Subject Code	21CTCTP701C	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: Introduction			**Hours**
Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments, and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices. GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS. *(Wireless) Medium Access Control (MAC):* Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Wireless LAN/(IEEE 802.11)			10
Unit -2 : Mobile Network Layer			
IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP.			**10**
Unit – 3: Mobile Transport Layer			
Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks. *Database Issues:* Database Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process &QoS Issues.			**10**
Unit – 4: 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.			**08**
Unit – 5: Mobile Ad hoc Networks			
Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc., Mobile Agents, Service Discovery. *Protocols and Platforms for Mobile Computing:* WAP, Bluetooth, XML, J2ME, Java Card, PalmOS, Windows CE, SymbianOS, Linux for Mobile Devices, Android.			**10**

Text(T) / Reference(R) Books:	
T1	Mobile Communications, Jochen Schiller, Addison-Wesley, Second Edition, 2009
T2	Mobile Computing, Raj Kamal, Oxford University Press, 2007.
R1	Mobile Computing, Technology Applications and Service Creation, ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, Second Edition, Mc Graw Hill
R2	Principles of Mobile Computing, UWE Hansmann, LotherMerk, Martin S. Nocklous, Thomas Stober, Second Edition, Springer.
W1	https://swayam.gov.in/course/3696-mobile-computing
W2	https://onlinecourses.nptel.ac.in/noc16_cs13/preview

Course Outcomes: On completion of this course, students can	
CO1	To think and develop new mobile application.
CO2	To take any new technical issue related to this new paradigm and come up with a solution(s).
CO3	To develop new ad hoc network applications and/or algorithms/protocols.
CO4	To understand & develop any existing mobile time environment.
CO5	To understand & develop new protocol related to mobile time environment.

SOFT COMPUTING			
Subject Code	21CTCTP702A	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:
In the course the student will Learn soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world problems.

Unit -1: Fuzzy Set Theory	**Hours**
Introduction to Neuro – Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations. Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models. .	10
Unit -2: Optimization	
Derivative based Optimization, Descent Methods, The Method ofSteepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms.	**10**
Unit – 3: Artificial Intelligence	
Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Prepositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning, Heuristic Search: Techniques for Heuristic search Heuristic Classification.	**10**
Unit – 4: Neuro Fuzzy Modeling	
Adaptive Neuro-Fuzzy Inference Systems, Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN, Framework Neuron Functions for Adaptive Networks, Neuro Fuzzy Spectrum.	**10**
Unit – 5: Applications Of Computational Intelligence	
Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.	**08**

Text(T) / Reference® Books:	
T1	J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004
T2	N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.
R1	Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
R2	Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
R3	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI,

Course Outcomes: On completion of this course, students can	
CO1	Able to apply fuzzy logic and reasoning to handle uncertainty in engineering problems Make use of genetic algorithms to combinatorial optimization problems
CO2	Apply artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning.
CO3	Learn and apply the principles of self adopting and self organizingneuro fuzzy inference systems .
CO4	Evaluate and compare solutions by various soft computing approaches for a given problem.

HUMAN COMPUTER INTERACTION			
Subject Code	21CTCTP702B	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. To facilitate communication between students of psychology, design, and computer science on user interface development projects.
2. provide the future user interface designer with concepts and strategies for making design decisions.
3. expose the future user interface designer to tools, techniques, and ideas for interface design.
4. introduce the student to the literature of human-computer interaction and to stress the importance of good user interface design

Unit -1: Introduction	**Hours**
Importance of user Interface, definition, importance of good design. Benefits of good design. A brief history of Screen design, The graphical user interface, popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user Interface popularity, characteristics, Principles of user interface.	**10**
Unit -2: Design process	
Human interaction with computers, importance of human characteristics, human consideration, Human interaction speeds, and understanding business junctions.	**10**
Unit – 3: Screen Designing	
Design goals, Screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, visually pleasing composition, amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design.	**10**
Unit – 4: Windows	
New and Navigation schemes selection of window, selection of devices based and screen based controls, Components, text and messages, Icons and increases, Multimedia, colors, uses problems, choosing colors.	**10**
Unit – 5: Software tools	
Specification methods, interface, Building Tools, Interaction Devices, Keyboard and function keys, pointing devices, speech recognition digitization and generation, image and video displays, drivers.	**08**

Text(T) / Reference® Books:	
T1	"The essential guide to user interface design", Wilbert O Galitz, Wiley Dream Tech.
T2	"Designing the user interface", 3rdEdition, Ben Shneidermann, Pearson Education Asia.
R1	"Human Computer Interaction", Alan dix, janetfincay, gregoryd, Abowd, russellbealg, pearson.
R2	"Interaction Design", PRECE, ROGERS, SHARPS. Wiley Dreamtech,
R3	"User Interface Design", SorenLauesen , Pearson Education.

Course Outcomes: On completion of this course, students can	
CO1	Analyze Human-Computer Interaction principle and designs in Information Systems.
CO2	Compare various HCI designs to gain knowledge on user-centric interfaces.
CO3	Apply Information Systems tools to prototype the end-user design.
CO4	Develop end-user interfaces incorporating problem solving solutions in HCI.

COMPUTER VISION			
Subject Code	21CTCTP702C	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

5. To introduce students the fundamentals of image formation.
6. To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition.
7. To develop an appreciation for various issues in the design of computer vision and object recognition systems.
8. To provide the student with programming experience from implementing computer vision and object recognition applications.

Unit -1: Introduction	**Hours**
Image Formation: Geometric Primitives and Transformation, Photometric Image Formation, Digital Camera, Image Processing: Point Operators, Linear Filtering, More Neighborhood Operators, Fourier Transforms, Pyramids and Wavelets, Geometric Transformations, Global Optimization.	**10**
Unit -2: Feature Detection and Matching	
Points and Patches, Edges, Lines, Segmentation: Active Contours, Split and Merge, Mean Shift and Mode Finding, Normalized Cuts, Feature-Based Alignment: 2D and 3D Feature-based Alignment, Pose Estimation, Geometric Intrinsic Calibration.	**10**
Unit – 3: Structure and Motion	
Triangular, Two-frame Structure from Motion, Factorization, Bundle Adjustment, Constrained Structure and Motion, Dense Motion Estimation: Translation Alignment, Parametric Motion, Spline-based Motion, Optical Flow, Layered motion	**10**
Unit – 4: Image Stitching	
Motion Models, Global Alignment, Composing, Computational Photography: Photometric Calibration, High Dynamic Range Imaging, Super-Resolution and Blur Removal, image Matting and Compositing, Texture Analysis and Synthesis.	**08**
Unit – 5: 3D Reconstruction	
Shape From X, Active Range Finding, Surface Representation, Point based Representation, Volumetric Representation, Model-based Reconstruction, Recovering Texture Maps and Albedos, Image-based Rendering: View Interpolation, Layered Depth Images, Light Fields and Lumi graphs, Environment Mattes, Video-based Rendering.	**10**

Text(T) / Reference® Books:	
T1	Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2011.
T2	Simon J.D Prince, Computer Vision: Models, Learning and Inference, 1st Edition, 2012.
R1	Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
R2	Haralick & Shapiro, "Computer and Robot Vision", Vol II
R3	G_erard Medioni and Sing Bing Kang "Emerging topics in computer vision"166
R4	https://onlinecourses.nptel.ac.in/noc22_ee48/preview

Course Outcomes: On completion of this course, students can	
CO1	Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
CO2	Describe known principles of feature detection and matching.
CO3	Describe basic methods of computer vision related to image stitching, photography like high dynamic range imaging and blur removal.
CO4	Suggest a design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths.

DEEP LEARNING			
Subject Code	21CTCTP703A	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Learn deep learning methods for working with sequential data.
2. Learn deep recurrent and memory networks.
3. Learn deep Turing machines.
4. Apply such deep learning mechanisms to various learning problems.
5. Know the open issues in deep learning, and have a grasp of the current research directions.

Unit -1: Fundamentals of Deep Learning	**Hours**
Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, Fundamentals of Machine Learning: Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting.	**08**
Unit -2: Introducing Deep Learning	
Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks.	**10**
Unit – 3: Neural Networks	
Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification.	**10**
Unit – 4: Convolutional Neural Networks	
Nerual Network and Representation Learing, Convolutional Layers, Multichannel Convolution Operation, Recurrent Neural Networks: Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch.	**10**
Unit – 5: Interactive Applications of Deep Learning	
Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. **Deep Learning Research**: Autoencoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks.	**08**

Text(T) / Reference(R) Books:

T1	Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courvile, MIT Press, 2016
T2	Deep Learning with Python - Francois Chollet, Released December 2017, Publisher(s): Manning Publications, ISBN: 9781617294433
T3	Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional, ISBN: 9780135116821
T4	Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492041412
R1	Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
R2	Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
R3	Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.
W1	Swayam NPTEL: Deep Learning: https://onlinecourses.nptel.ac.in/noc22_cs22/preview

Course Outcomes: On completion of this course, students can	
CO1	Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.
CO2	Discuss the Neural Network training, various random models.
CO3	Explain the Techniques of Keras, TensorFlow, Theano and CNTK
CO4	Classify the Concepts of CNN and RNN.
CO5	Implement Interactive Applications of Deep Learning.

DATA VISUALIZATION			
Subject Code	21CTCTP703B	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

On completion of this course, the student will be able to □

1. Identify and recognize visual perception and representation of data. □
2. Illustrate about projections of different views of objects. □
3. Apply various Interaction and visualization techniques. □
4. Analyze various groups for visualization. □
5. Evaluate visualizations

Unit -1: Introduction to Data Visualizations and Perception	**Hours**
Introduction of visual perception, visual representation of data, Gestalt principles, Information overload.	**10**
Unit -2: Visual Representations	
Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.	**08**
Unit – 3: Classification of Visualization Systems	
Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.	**10**
Unit – 4: Visualization of Groups	
Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.	**10**
Unit – 5: Visualization of Volumetric Data And Evaluation of Visualizations	
Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations	**10**

Text(T) / Reference(R) Books:	
T1	Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative andCompelling Figures", 1st edition, O'Reilly Media Inc, 2019.
T2	Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, 2018
R1	Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O'Reilly, 2016

Course Outcomes: On completion of this course, students can	
CO1	Understand basics of Data Visualization
CO2	Implement visualization of distributions
CO3	Write programs on visualization of time series, proportions& associations
CO4	Apply visualization on Trends and uncertainty
CO5	Explain principles of proportions

WIRELESS NETWORK SECURITY			
Subject Code	21CTCTP703C	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

1. The objective of this course is to understand the importance of Wireless networks security and its application

Unit -1: Introduction	**Hours**
Introduction to Wireless: History of Wireless Technologies, History of Wireless Security, State of the Wireless Security Industry, 2001 Wireless Threats: Uncontrolled Terrain, Communications Jamming, DoS Jamming, Injections and Modifications of Data, Man-in-the-Middle (MITM) Attack, Rogue Client, Rogue Network Access Points, Attacker Equipment	**10**
Unit -2: Introduction to Wireless Security Protocols and Cryptography	
Recovery the FUD, OSI Model, OSI Simplified, Internet Model, Wireless LAN Security Protocols, Cryptography, SSL/TLS, Secure Shell Protocols, Terminal Access and File Transfer, Port Forwarding a Word of Caution, Man-inthe-Middle of SSL/TLS and SSH, WTLS, WEP,802.1x, IP Security	**10**
Unit – 3: Security Considerations to Wireless Devices	
Wireless Device Security Issues, Physical Security, Information Leakage, Device Security Features, Application Security, Detailed Device Analysis, Laptops, Personal Digital Assistants (PDAS), Wireless Infrastructure Wireless Technologies and Applications: Introduction to Cellular Networks- FDMA, TDMA, CDMA, Spread Spectrum Primer, Analogy, TDMA Vs CDMA, PDC, Security Threats	**10**
Unit – 4: Introduction to Wireless Data Networks	
Cellular Digital Packet Data (CDPD), CDPD Architecture, CDPD Security, Mobitex- Mobitex Architecture, Mobitex Security Architecture, Security Issues, Gateway, Security Model Wireless Standards and Technologies: Current and Future Technologies- Infrared, Radio, Spread Spectrum, OFDM, Current and Future Standards- IEEE 802 Standards, ETSI, Home RF, Ultra-wide band Radio (UWB)	**10**
Unit – 5: Wireless Deployment Strategies	
Implementing Wireless LAN's- Security Considerations Common Wireless Network Applications, Enterprise Campus Designs, Wireless IST Design, Retail and Manufacturing Design, Small Office/Home Office Design (SOHO)	**08**

Text(T) / Reference(R) Books:

T1	Wireless Security, Merritt Maxim and David Pollino, Osborne/McGraw Hill, New Delhi
T2	Wireless Security Models: Threats and Solutions, Nichols and Lekka, Tata McGraw Hill, New Delh
R1	Behrouz A.Forouzan, ―Cryptography & Network Security‖, Tata McGraw Hill, India, New Delhi
R2	William Stallings, ―Cryptography and Network Security, Prentice Hall, New Delhi
R3	Bruce Schneier, "Applied Cryptography", John Wiley & Sons, New York

Text(T) / Reference(R) Books:	
T1	Wireless Security, Merritt Maxim and David Pollino, Osborne/McGraw Hill, New Delhi
T2	Wireless Security Models: Threats and Solutions, Nichols and Lekka, Tata McGraw Hill, New Delh
R1	Behrouz A.Forouzan, ―Cryptography & Network Security‖, Tata McGraw Hill, India, New Delhi
R2	William Stallings, ―Cryptography and Network Security, Prentice Hall, New Delhi
R3	Bruce Schneier, "Applied Cryptography", John Wiley & Sons, New York

MANAGEMENT SCIENCE

Subject Code	21CTMST7060	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03

Credits – 03

Course objectives:

1. To understand the concept of Management its nature importance, Management theories, concept of decision making and organization principles and structures.
2. To understand the concept of production management in the organization. Work study, SQC, inventory management and its techniques.
3. To understand the concept of HRM and its functions, Marketing Management, Strategic management its components.
4. To understand the concept of project management PERT, CPM and Project Crashing.
5. To understand the concepts of recent trends in management

Unit -I: Introduction to Management	**Hours**
Concept –nature and importance of Management – Functions of Management – Evaluation of Management thought- Theories of Motivation –Decision-making process – Designing organization Structure - Principles of organization - Types of organization structure.	**10**
Unit -II: Operations Management	
Nature & Objectives of OM-Production Methods-Plant Location & Layout Study &its significance – Work study- Statistical Quality Control-Control charts (P-chart, R-chart, and C chart). Simple problems- Material Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis(HML,SDE, VED, and FSN analysis).	**10**
Unit-III: Functional Management & Strategic Management	
Functional Management: Concept of HRM, HRD and PMIR-Functions of HRM - Marketing Management- Functions of Marketing, Marketing strategies based on product Life Cycle, Channels of distributions. **Strategic Management**: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis-Steps in Strategy Formulation and Implementation, Generic Strategy alternatives	**10**
Unit –IV: Project Management: (PERT/CPM)	
Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems).	**10**
Unit-V: Contemporary Management Practices	
Basic concepts of MIS, MRP, Justin- Time (JIT) system, Total Quality Management (TQM), Six sigma, Supply Chain Management, Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Business process Re-engineering and Bench Marking, Balanced Score Card.	**08**

Text(T) / Reference(R) Books:

T1	Dr. P. Vijaya Kumar & Dr. N. Appa Rao, '*Management Science'* Cengage, Delhi, 2012.
T2	Dr. A. R. Aryasri, *Management Science'* TMH 2011.
R1	Koontz & Weihrich: 'Essentials of Management' TMH 2011
R2	Seth & Rastogi: Global Management Systems, Cengage Learning, Delhi, 2011.
R3	Robbins: Organizational Behaviors, Pearson Publications, 2011
R4	Kanishka Bedi: Production & Operational Management, Oxford Publications, 2011.
R5	Manjunath: Management Science, Pearson Publications, 2013.
R6	Biswajit Patnaik: Human Resource Management, PHI, 2011.
R7	Hitt and Vijaya Kumar: Strategic Management, Cengage Learning.

Course Outcomes: On completion of this course, students can	
CO1	Students are able to understand the concept and functions of Management, and Theories of Motivation, Styles of Leadership.
CO2	Students are able to understand the Statistical Quality Control Techniques, Methods of inspection, the concept of Inventory Management and Control.
CO3	Students are understand the functional areas of organization i.e., Marketing Management, Human Resource Management, and Strategic Management
CO4	Students are able to understand Project Management Techniques.
CO5	Students are able to Understand the various contemporary issues in Management Practices like TQM and BPO etc.

ETL DESIGN PROCEDURES-SPARK			
Subject Code	21CTCTS7070	IA Marks	15
Number of Tutorial Hours/Week	03(P)	Exam Marks	35

Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

Course Objective:

- Get exposure on Spark for ETL

Course Outcomes:

By completing the course the students will be able to:

- Develop various applications for ETL with Spark

List of Experiments:

1. Write a program to create a Spark Session and read the data from CSV file
2. Write a program to group record of Supermarket's sales data of Kaggle Dataset by Gender
3. Write a program to create a Spark Session and display DataFrame of employee.json
4. Write a program to perform various operations of Spark SQL
5. Write a program to create a new data pipeline with Apache Spark
6. Write a program to Run SQL queries on the data in Parquet table
7. Write a program to develop Parquet table to a platform data container.
8. Write a program to Run SQL queries on the data in NoSQL table
9. Write a program to change the data in an existing Delta Lake table
10. Write a program to create a new ingestion pipeline with Apache Spark

OPEN ELECTIVES COURSES OFFERED BY CSE

TO

OTHER DEPARTMENTS

V SEM OPEN ELECTIVE COURSES

S. No	Subject Code	Name of the subject	L	T	P	CREDITS
1.	21XXCSO50XA	Data Structures through C	3	0	0	3
2.	21XXCSO50XB	Operating Systems Concepts	3	0	0	3
3.	21XXCSO50XC	Java Programming	3	0	0	3

VI SEM OPEN ELECTIVE COURSES

S. No	Subject Code	Name of the subject	L	T	P	CREDITS
1.	21XXCSO60XA	R Programming	3	0	0	3
2.	21XXCSO60XB	Designing Data Base Management Systems	3	0	0	3
3.	21XXCSO60XC	APP Technologies	3	0	0	3

VII SEM OPEN ELECTIVE COURSES

S. No	Subject Code	Name of the subject	L	T	P	CREDITS
1.	21XXCSO70XA	Web Technologies	3	0	0	3
2.	21XXCSO70XB	Artificial Intelligence	3	0	0	3
3.	21XXCSO70XC	Software Engineering	3	0	0	3

DATA STRUCTURES THROUGH C			
Subject Code	21XXCSO50XA	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Operations on linear data structures and their applications.
2. The various operations on linked lists.
3. The basic concepts of Trees, Traversal methods and operations.
4. Concepts of implementing graphs and its relevant algorithms.
5. Sorting and searching algorithms.

Unit -1: INTRODUCTION TO DATA STRUCTURE	**Hours**
Data Management concepts, Data types – primitive and non-primitive, Performance Analysis and Measurement (Time and space analysis of algorithms-Average, best- and worst-case analysis), Types of Data Structures- Linear & Non-Linear Data Structures. Sorting and Searching: Sorting – Bubble Sort, Selection Sort, Quick Sort, Merge Sort Searching – Sequential Search and Binary Search	**10**
Unit -2: LINEAR DATA STRUCTURE	
Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion. Queue: Representation Of Queue, Operations On Queue, Circular Queue, Double Ended Queue, Applications of Queue.	**10**
Unit – 3: LINKED LIST	
Linked List: Singly Linked List, Doubly Linked list, Circular linked list ,Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	**10**
Unit – 4: NON-LINEAR DATA STRUCTURE	

Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Binary search trees, Conversion of General Trees to Binary Trees, Applications of Trees.	**10**
Unit – 5:GRAPHS	
Graph-Matrix Representation of Graphs, Elementary Graph operations, (Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)	**08**

Text(T) / Reference(R) Books:	
T1	Data Structures using C -By Reema Thareja - OXFORD Higher Publication
T2	Data Structures using C & C++ -By Ten Baum Publisher – Prenctice-Hall International
R1	Fundamentals of Computer Algorithms by Horowitz, Sahni,Galgotia Pub. 2001 ed
R2	Fundamentals of Data Structures in C++-By Sartaj Sahani.
R3	Data Structures: A Pseudo-code approach with C -By Gilberg & Forouzan Publisher Thomson Learning
W1	https://www.coursera.org/specializations/data-structures-algorithms
W2	https://online-learning.harvard.edu/course/data-structures-and-algorithms

Course Outcomes: On completion of this course, students can	
CO1	Choose appropriate data structure as applied to specified problem definition.
CO2	Handle operations like searching, insertion, deletion, traversing mechanism etc.
CO3	Apply concepts learned in various domains like DBMS
CO4	Apply concepts learned in various domains like compiler construction
CO5	Use linear and non-linear data structures like stacks, queues , linked list

OPERATING SYSTEMS			
Subject Code	21XXCSO50XB	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: Operating Systems Overview			**Hours**
Computer system organization, Operating system structure, Process, memory, storage management, Protection and security, Distributed systems, Computing Environments, Open-source operating systems, OS services, User operating-system interface.			**10**
Unit -2 : System Calls & IPC			
System calls, Types, System programs, OS structure, OS generation, System Boot Process concept, scheduling (Operations on processes, Cooperating processes, Inter-process communication), Multi-threading models			**10**
Unit - 3: Process Management			
Basic concepts, Scheduling criteria, Scheduling algorithms, Thread scheduling, Multiple processor scheduling Operating system, Algorithm Evaluation, The critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Critical regions, Monitors.			**10**
Unit - 4: Memory Management & Dead lock			
System model, Deadlock characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock detection, Recovery from deadlock. Storage Management: Swapping, Contiguous memory allocation, Paging, Segmentation Virtual Memory Background, Demand paging, copy on write, Page replacement and various Page replacement algorithms, Allocation of frames, Thrashing.			**10**
Unit - 5: I/O Systems			
File concept, Access methods, Directory structure, Filesystem mounting, Protection, Directory implementation, Allocation methods, Free-space management, Disk scheduling, Disk management, Swap-space management, Protection.			**08**

Text(T) / Reference(R) Books:	
T1	Operating System Concepts Essentials, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, John Wiley & Sons Inc., 2010.
T2	Operating System Concepts, 9th Edition, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, John Wiley and Sons Inc., 2012
T3	Operating Systems, Second Edition, S Halder, Alex A Aravind, Pearson Education, 2016
T4	Operating Systems – Internals and Design Principles, 7th Edition, William Stallings, Prentice Hall, 2011
R1	Modern Operating Systems, Second Edition, Andrew S. Tanenbaum, Addison Wesley, 2001.
R2	Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata McGraw Hill Education, 1996.
R3	Operating Systems: A Concept-based Approach, Second Edition, D M Dhamdhere, Tata McGraw-Hill Education, 2007
R4	Operating Systems: Internals and Design Principles, Seventh Edition, William Stallings, Prentice Hall, 2011
W1	https://www.coursera.org/courses?query=operating%20system
W2	https://onlinecourses.nptel.ac.in/noc16_cs10/preview

Course Outcomes: On completion of this course, students can	
CO1	Demonstrate the evolution of Computer System organization and Operating system services.
CO2	Design solutions for process synchronization problems by using System calls and Inter process communication.
CO3	Identify the functionality involved in process management concepts like scheduling and synchronization.
CO4	Design models for handling deadlock and perform memory management.
CO5	Analyze services of I/O subsystems and mechanisms of security & protection.

JAVA PROGRAMMING			
Subject Code	21XXCSO50XC	**IA Marks**	30
Number of Lecture Hours/Week	03	**Exam Marks**	70
Total Number of Lecture Hours	48	**Exam Hours**	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Understanding the OOP's concepts, classes and objects, threads, files, applets, swings and act.
2. This course introduces computer programming using the JAVA programming language with object-oriented programming principles.
3. Emphasis is placed on event-driven programming methods, including creating and manipulating objects, classes, and using Java for network level programming and middleware development.

Unit -1: Introduction to OOP	**Hours**
procedural programming language and object-oriented language, principles of OOP, applications of OOP, history of java, java features, JVM, program structure. Variables, primitive data types, identifiers, literals, operators, expressions, precedence rules and associativity, primitive type conversion and casting, flow of control.	**10**
Unit -2 : Classes and objects	
Classes and objects, class declaration, creating objects, methods, constructors and constructor overloading, garbage collector, importance of static keyword and examples, this keyword, arrays, command line arguments, nested classes.	**10**
Unit – 3: Inheritance	
Inheritance, types of inheritance, super keyword, final keyword, overriding and abstract class. Interfaces, creating the packages, using packages, the importance of CLASSPATH and java.lang package. Exception handling, the importance of try, catch, throw, throws and finally block, user defined exceptions, Assertions	**10**
Unit – 4: Multithreading	
Introduction, thread life cycle, creation of threads, thread priorities, thread synchronization, communication between threads. Reading data from files and writing data to files, random access file.	**10**
Unit – 5: Applet	
Applet class, Applet structure, Applet life cycle, sample Applet programs. Event handling: event delegation model, sources of event, Event Listeners, adapter	**08**

classes, inner classes. AWT: introduction, components and containers, Button, Label, Checkbox, Radio Buttons, List Boxes, Choice Boxes, Container class, Layouts, Menu and Scrollbar.	

Text(T) / Reference(R) Books:	
T1	The complete Reference Java, 8th edition, Herbert Schildt, TMH
T2	Programming in JAVA, Sachin Malhotra, Saurabh Choudary, Oxford
R1	Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
W1	https://www.coursera.org/courses?query=java
W2	https://www.udemy.com/java-tutorial/

Course Outcomes: On completion of this course, students can	
CO1	Understand Java programming concepts and utilize Java Graphical User Interface in Program writing.
CO2	Write, compile, execute and troubleshoot Java programming for networking concepts.
CO3	Build Java Application for distributed environment.
CO4	Design and Develop multi-tier applications.
CO5	Identify and Analyze Enterprise applications.

R PROGRAMMING			
Subject Code	21XXCSO60XA	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Unit -1: Introduction	**Hours**
How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes**.**	10
Unit -2 :	
R Programming Structures, Control Statements, Loops,-Looping Over Nonvector Sets,- If-Else Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation- Extended Extended Example: A Binary Search Tree.	**10**
Unit – 3: Math and Simulation in R	
Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability- Cumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /out put, Accessing the Keyboard and Monitor, Reading and writer Files	**10**
Unit – 4: Graphics	
Creating Graphs, The Workhorse of R Base Graphics, the plot() Function – Customizing Graphs, Saving Graphs to Files, Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,- ANOVA.	**10**
Unit – 5: Linear Models	
Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests	**08**

Text(T) / Reference(R) Books:	
T1	The Art of R Programming, Norman Matloff, Cengage Learning

T2	R for Everyone, Lander, Pearson
R1	R Cookbook, PaulTeetor, Oreilly
R2	R in Action, Rob Kabacoff, Manning
W1	https://www.edx.org/learn/r-programming
W2	https://www.coursera.org/learn/r-programming

Course Outcomes: On completion of this course, students can	
CO1	Identify the data types in R Programming Language.
CO2	Implement the control and functions with recursion and without recursion.
CO3	Implement the statistical and probabilistic functions to review, manipulate and summarize data-sets in R
CO4	Perform appropriate statistical tests using R Create and edit visualizations
CO5	Interpret data-sets to create testable hypotheses and identify appropriate statistical tests

DESIGNING DATABASE MANAGEMENT SYSTEMS			
Subject Code	21XXCSO60XB	IA Marks	30
Number of Lecture Hours/week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			
Unit -1: Introduction to Databases			Hours
Traditional file-based systems and their limitations, Database approach (DBMS) and its components, Roles in the database environment, Advantages and disadvantages of database systems, Distributed databases.			10
Unit -2 : The Relational Model			
Definition of relational data structures, database relations and keys, Representation of relational database schemas, Relational Algebra, Relational integrity (entities and relationships), Views			10
Unit – 3: Structured Query Language			
Introduction, objectives, terminology, Data manipulationQuerying, sorting, grouping of data, logical and list operators, Single row numeric and string functions, Group functions, Joins, Sub-queries,Inserting, deleting and updating data. Data definition- Creating, altering and dropping database objects: tables, views, indexes, synonyms, constraints, users. Creating Procedures and Functions, Creating Database Triggers.			10
Unit – 4: Entity–Relationship Modelling and Logical Database Design			
Entity and Relationship Types, Attributes (single, composite and derived), Structural Constraints (1:1, 1:*, *:* relationships), Multiplicity, Cardinality and participation.			10
Unit – 5: Normalization			
Update anomalies, Functional dependencies, First, second, and third normal forms.			08

Text(T) / Reference(R) Books:	
T1	The Semantic Web, Berners-Lee, T., Hendler, J. and Lassila, Scientific American, 279, 2001.
T2	Extending the database relational model to capture more meaning, Codd, E.F., ACM Transactions on Database Systems (TODS), v.4 n.4, p.397-434
T3	Fundamentals of database systems, Elmasri, R., &Navathe, S., Pearson Addison Wesley.
R1	Database systems: a practical approach to design, implementation, and management, Connolly, T. &Begg, C, Addison-Wesley
W1	https://onlinecourses.nptel.ac.in/noc18_cs15/preview
W2	https://www.edx.org/learn/databases
Course Outcomes: On completion of this course, students can	
CO1	Demonstrate understanding of the fundamental concepts of the relational database model and utilize database management systems to organize, store and retrieve data.
CO2	Make use of SQL (Structured Query Language) for database definition and manipulation, use of a conventional programming language to implement database connections.
CO3	Apply conceptual database modelling methods such as entity-relationship to model business requirements.

CO4	Make use of a step-by-step approach from conceptual and logical to a physical model to design databases.
CO5	Identify functional dependencies and apply normal forms to evaluate the quality of a relational database design.

APP TECHNOLOGIES			
Subject Code	21XXCSO60XC	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

- To provide in depth knowledge and hands on experience in application development, the latest trends and features.

Unit -1: Android Programming Environment	**Hours**
Android programming environment, linking activities using intents, calling built-in applications using intents.	10
Unit -2:User Interface	
Creating the user interface programmatically, Listening for UI notifications, build basic views, build picker views, build list views, Using image views, Using menus with views, Saving and loading user preferences	**10**
Unit – 3:Data	
Persisting data to files, Creating and using databases, Study Session, sharing data in android, Using a content provider, Creating a content provider	**10**
Unit – 4: Networking	
SMS messaging, sending emails, Networking, displaying maps, Getting location data	**10**
Unit – 5: Services	
Creating your own services, communicating between a service and an Activity, Binding Activities to Services, A complete lab work for Android service development, Deploy APK files.	**08**

Text(T) / Reference(R) Books:	
T1	Beginning Android Application Development, Wei-Meng Lee, 1st Ed, Wiley Publishing.
T2	Android: A Programmers Guide, J. F. DiMarzio, McGraw Hill Education (India) Private Limited.1st Edition.

R1	Android for Programmers: An App-Driven Approach, Paul Deitel, 1st Edition, Pearson India
R2	Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India Pvt Ltd
W1	https://www.coursera.org/browse/computer-science/mobile-and-web-development
W2	https://in.udacity.com/course/new-android-fundamentals--ud851

Course Outcomes: On completion of this course, students can	
CO1	Demonstrate their understanding of the fundamentals of Android operating systems
CO2	Demonstrate their skills of using Android software development tools
CO3	Demonstrate their ability to develop software with reasonable complexity on mobile platform
CO4	Demonstrate their ability to deploy software to mobile devices
CO5	Demonstrate their ability to debug programs running on mobile devices

WEB TECHNOLOGIES			
Subject Code	21XXCSO70XA	**IA Marks**	30
Number of Lecture Hours/Week	03	**Exam Marks**	70
Total Number of Lecture Hours	48	**Exam Hours**	03
Credits – 03			

Course Objectives:

The main objective of this course is to provide basic knowledge of web design using HTML and CSS, client side scripting using JavaScript, handling web data using XML and server side scripting using PHP.

Unit-1: HTML	**Hours**
Introduction to HTML; Elements of HTML Document; HTML Elements and HTML Attributes, Headings, Paragraph, Division, Formating: b, i, small, sup, sub; Spacing: Pre, Br; Formatting Text Phrases: span, strong, tt; Image element; Anchors; Lists: Ordered and Unordered and Definition; Tables; Frames; Forms: Form Elements, ID attributes, Class Attributes of HTML Elements; Meta Tag, Audio, Video, Canvas, Main, Section, Article, Header, Footer, Aside, Nav, Figure Tags; HTML Events: Window Events, Form Element Events, Keyboard Events, Mouse Events	**10**
Unit -2: Cascading Style Sheets	
Introduction; Cascading Style Sheets (CSS); CSS Syntax; Inserting CSS: Inline, Internal, External, ID and Class Selectors; Colors; Backgrounds; Borders; Text; Font; List; Table; CSS Box Model; Normal Flow Box Layout: Basic Box Layout, Display Property, Padding, Margin; Positioning: Relative, Float, Absolute; CSS3 Borders, Box Shadows, Text Effects and shadow; Basics of Responsive Web Designs; Media Queries, Introduction to Bootstrap	**10**
Unit –3: Client Side Scripting with JavaScript	
Structure of JavaScript Program; Variables and Data Types; Statements: Expression, Keyword, Block; Operators; Flow Controls, Looping, Functions; Popup Boxes: Alert, Confirm, Prompt; Objects and properties; Constructors; Arrays; Built-in Objects: Window, String, Number, Boolean, Date, Math, RegExp, Form, DOM; User Defined Objects; Event Handling and Form Validation, Error Handling, Handling Cookies, jQuery Syntax; jQuery Selectors, Events and Effects; Introduction to JSON	**10**
Unit -4: AJAX and XML	

Basics of AJAX; Introduction to XML and its Application; Syntax Rules for creating XML document; XML Elements; XML Attributes; XML Tree; XML Namespace; XML schema languages: Document Type Definition(DTD), XML Schema Definition (XSD); XSD Simple Types, XSD Attributes; XSD Complex Types; XML Style Sheets (XSLT), XQuery	**10**
Unit – 5: Server Side Scripting using PHP	
PHP Syntax, Variables, Data Types , Strings, Constants, Operators, Control structure, Functions, Array, Creating Class and Objects, PHP Forms, accessing Form Elements, Form Validation, Events, Cookies and Sessions, Working with PHP and MySQL, Connecting to Database, Creating, Selecting, Deleting, Updating Records in a table, Inserting Multiple Data, Introduction to CodeIgniter, Laravel, Wordpress etc.	**08**

Text(T) / Reference(R) Books:	
T1	Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013
T2	Web Technologies, 1st Edition 7th impression, Uttam K Roy, Oxford, 2012.
T3	Introduction to JavaScript by Lindsay Bassett, 2015.
T4	Introduction to YAML: Demystifying YAML Data Serialization Format by Tarun Telang
T5	Full-Stack Vue.Js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel
R1	Programming world wide web, Sebesta, Pearson
R2	An Introduction to web Design and Programming, Wang, Thomson
W1	https://www.edx.org/learn/web-development
W2	https://www.javatpoint.com/what-is-json
W3	https://www.javatpoint.com/yaml-scalars
W4	https://www.javatpoint.com/laravel-blade-template

Course Outcomes: On completion of this course, students can	
CO1	To develop a dynamic webpage by the use of HTML
CO2	To develop a dynamic webpage by the use of CSS
CO3	To develop a dynamic webpage by the use of JSON
CO4	To develop a dynamic webpage by the use of YML
CO5	Build web applications using PHP
CO6	To develop a dynamic webpage by the use of Laravel

ARTIFICIAL INTELLIGENCE			
Subject Code	21XXCSO70XB	**IA Marks**	30
Number of Lecture Hours/Week	03	**Exam Marks**	70
Total Number of Lecture Hours	48	**Exam Hours**	03
Credits – 03			

Course Objectives:

The learning objectives of this course are

1. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language
2. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs
3. To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.

Unit -1: Introduction to artificial intelligence	**Hours**
Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI.	**09**
Unit -2 : Problem solving: state-space search and control strategies	
Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative deepening a*, constraint satisfaction.	**10**
Unit – 3:Problem reduction, Game playing	
Problem Reduction: Introduction, Problem reduction using AO* algorithm, Towers of Hanoi problem, Matrix Multiplication problem game playing, alpha-beta pruning, two-player perfect information games.	**10**
Unit – 4: Logic Concepts & Knowledge Representation Techniques	
Logic Concepts: Introduction, propositional calculus, propositional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic. Introduction to KR techniques, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.	**10**
Unit – 5: Expert systems and its applications	

Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems, blackboard systems, truth maintenance systems, application of expert systems, list of shells and tools.	**09**

Text(T) / Reference(R) Books:	
T1	Artificial Intelligence- Saroj Kaushik, CENGAGE Learning
T2	Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, PEA
T3	Artificial Intelligence- Rich, Kevin Knight, Shiv Shankar B Nair, 3rded, TMH
T4	Introduction to Artificial Intelligence, Patterson, PHI
R1	Artificial intelligence, structures and Strategies for Complex problem solving, - George F Lugar, 5thed, PEA
R2	Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer
R3	Artificial Intelligence, A new Synthesis, Nils J Nilsson, Elsevier
R4	AI: A Modern Approach, Stuart Russell and Peter Norvig, Additional Readings: Marr, Bishop, occasionally others
W1	https://www.edx.org/learn/artificial-intelligence
W2	https://www.coursera.org/courses?query=artificial%20intelligence

Course Outcomes: On completion of this course, students can	
CO1	To introduce basic concepts of AI with its working principles.
CO2	To understand different kinds of heuristic search algorithms to get feasible solution for AI problems.
CO3	To understand problem reduction concepts using various problem reduction techniques. (Ex: Problem reduction using AO* algorithm, Towers of Hanoi problem, Matrix Multiplication problem)
CO4	To understand various Knowledge Representation (KR) techniques
CO5	To understand different kinds of Expert Systems.

SOFTWARE ENGINEERING			
Subject Code	21XXCSO70XC	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			
Unit -1: Software and Software Engineering			**Hours**
Introduction to Software Engineering: The Nature of Software, The Unique Nature of Web Apps, Software Engineering, Software Process, Software Engineering Practice, Software Myths. **Process Models:** A Generic Process Model, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Product and Process, Process Terminology, Process Assessment and Improvement.			**10**
Unit -2: Software Requirements & Design			
Requirements Analysis and Specification: Requirements Gathering and Analysis, Software Requirement Specification (SRS), Formal System Specification. **Overview of the Design Process:** How to Characterize a Design, Cohesion and Coupling, Layered Arrangement of Modules, Approaches to Software Design. Function-Oriented Software Design: Overview of SA/SD Methodology, Structured analysis, Developing the DFD Model of a System, Structured Design, Detailed Design, Design Review, overview of Object-Oriented design.			**12**
Unit – 3: Coding and Testing			
Coding: Coding Principles, Coding Standards, Code Review, Software Documentation **Testing**: Unit Testing, Integration Testing, System Testing, Black-Box Testing, White-Box Testing, Debugging, Program Analysis Tool, Testing Object-Oriented Programs, Some General Issues Associated with Testing.			**10**
Unit – 4: Software Reliability and Quality Management & CASE			
Software Reliability: Reliability, Statistical Testing, **Software Quality:** Software Quality Management System, ISO 9000, SEI Capability Maturity Model. **Computer Aided Software Engineering:** CASE and its Scope, CASE Environment, CASE Support in Software Life Cycle, Other Characteristics of CASE tools, Towards Second Generation CASE Tool, Architecture of a CASE Environment.			**10**
Unit – 5: Software Maintenance			
Software Maintenance: Maintenance Process Models, Maintenance Cost, Software Configuration Management. **Software Reuse:** what can be reused? Why Almost No Reuse So Far? Basic Issues in Reuse Approach, Reuse at organization Level.			**08**

Text(T) / Reference(R) Books:	
T1	Software engineering A practitioner's Approach, Roger S. Pressman, Seventh Edition McGrawHill International Edition.
T2	Fundamentals of Software Engineering, Third Edition, Rajib Mall, PHI.
T3	Software Engineering, Ian Sommerville, Ninth edition, Pearson education
T4	Software Engineering, Concepts and Practices, Ugrasen Suman, Cengage Learning
R1	Software Engineering A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008
R2	Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India, 2010.

R3	Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press
R4	Software Engineering1: Abstraction and modeling, Diner Bjorner, Springer International edition, 2006.
R5	Software Engineering concepts, R. Fairley, TMH.
W1	https://www.edx.org/learn/software-engineering
W2	https://www.coursera.org/courses?query=software%20engineering

Course Outcomes:	
CO1	Define and develop software applications using different process models.
CO2	Describe the various design concepts to build real world software.
CO3	Interpret various coding and testing Techniques
CO4	Illustrate the Quality measures, Reliability Metrics and CASE Tools
CO5	Describe need of maintenance and reuse activities

OPEN ELECTIVES COURSES OFFERED BY CST

TO

OTHER DEPARTMENTS

V SEM OPEN ELECTIVE COURSES

S. No	Subject Code	Name of the subject	L	T	P	CREDITS
1.	21XXCTO50XA	Internet of Things	3	0	0	3
2.	21XXCTO50XB	Block Chain	3	0	0	3
3.	21XXCTO50XC	Quantum Computing	3	0	0	3

VI SEM OPEN ELECTIVE COURSES

S. No	Subject Code	Name of the subject	L	T	P	CREDITS
1.	21XXCTO60XA	Virtual Reality	3	0	0	3
2.	21XXCTO60XB	Data Structures through C	3	0	0	3
3.	21XXCTO60XC	Designing Database Management Systems	3	0	0	3

VII SEM OPEN ELECTIVE COURSES

S. No	Subject Code	Name of the subject	L	T	P	CREDITS
1.	21XXCTO70XA	Operating Systems Concepts	3	0	0	3
2.	21XXCTO70XB	R Programming	3	0	0	3
3.	21XXCTO70XC	Python Programming	3	0	0	3

S. No	Subject Code	Name of the subject	L	T	P	CREDITS
1.	21XXCTO70XA	Java Programming	3	0	0	3
2.	21XXCTO70XB	App Technologies	3	0	0	3
3.	21XXCTO70XC	Web Technologies	3	0	0	3

INTERNET OF THINGS			
Subject Code	21XXCTO50XA	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.

2. Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, as a Markov decision process, etc).

3. Implement basic AI algorithms (e.g., standard search algorithms or dynamic programming).

4. Design and carry out an empirical evaluation of different algorithms on problem formalization, and state the conclusions that the evaluation supports.

Unit -1: The Internet of Things	**Hours**
An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples OF IoTs, Design Principles for Connected Devices	**08**
Unit -2 :Business Models	
Business Processes in the Internet of Things ,IoT/M2M systems LAYERS AND designs standardizations ,Modified OSI Stack for the IoT/M2M Systems ,ETSI M2M domains and High-level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability	**10**
Unit – 3:Design Principles for the Web Connectivity	
Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.	**10**
Unit – 4:Internet Connectivity Principles	
Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet. Data Acquiring, Organizing and Analytics in IoT/M2M, Applications/Services/Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the	**10**

Internet of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.	
Unit – 5:Data Collection	
Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.	**10**

Text(T) / Reference(R) Books:	
T1	Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
T2	Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015
R1	Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley
R2	Getting Started with the Internet of Things CunoPfister , Oreilly
W1	https://www.coursera.org/specializations/internet-of-things
W2	https://alison.com/course/internet-of-things-and-the-cloud
Course Outcomes: On completion of this course, students can	
CO1	Demonstrate knowledge and understanding of the security and ethical issues of the Internet of Things
CO2	Conceptually identify vulnerabilities in Internet of Things
CO3	Conceptually identify recent attacks, involving the Internet of Things
CO4	Develop critical thinking skills
CO5	Compare and contrast the threat environment based on industry and/or device type.

BLOCK CHAIN TECHNOLOGY			
Subject Code	21XXCTO50XB	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. To assess blockchain applications in a structured manner.
2. To impart knowledge in block chain techniques and able to present the concepts clearly and structured.
3. To get familiarity with future currencies and to create own crypto token.

Unit -1: Introduction	**Hours**
Overview of Block chain, public ledgers, bitcoin, smart contracts, block in a block chain, transactions, distributed consensus, public vs private block chain, understanding crypto currency to block chain, permissioned model of block chain, overview of security aspects of block chain, cryptographic hash function, properties of a hash function, hash pointer and Merkle tree, digital signature, public key cryptography, a basic crypto currency.	**10**
Unit -2 :Understanding block chain with crypto currency	
Creation of coins, payments and double spending, bitcoin scripts, bitcoin P2P network, transaction in bitcoin network, block mining, block propagation and block relay, distributed consensus in open environments, consensus in a bitcoin network, Proof of Work (PoW)- Basic Introduction, hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of burn and proof of elapsed time, the life of a bitcoin miner, Mining- Difficulty, mining pool.	**10**
Unit – 3:Permissioned Block Chain	
Permissioned model and usecases, design issues for permissioned block chains, execute contracts, state machine replication, overview of consensus models for permissioned block chain, Distributed consensus in closed environment, paxos, RAFT consensus, Byzantine general problem, Byzantine fault tolerance system, Lamport-Shostak-Pease BFT algorithm, BFT over Asynchronous systems.	**10**
Unit – 4:Enterprise application of Block chain	
Cross border payments, Know Your Customer, Food security, Mortgage over block chain, Block chain enabled trade, trade finance network, supply chain financing, identity on block chain.	**08**
Unit – 5:Block chain application development	

Hyperledger fabric- architecture, identities and policies, membership and access control, channels, transaction validation, writing smart contract using Hyperledger fabric, writing smart contract using Ethereum, overview of Ripple and Corda.	**10**

Text(T) / Reference(R) Books:	
T1	Block Chain: Blueprint for a new economy, Melanie Swan, O'Reilly, 2015.
T2	Block Chain: The Block Chain for Beginners- Guide to Block Chain Technology and Leveraging Block Chain Programming, Josh Thompsons
R1	Block Chain Basics, Daniel Drescher, Apress; 1st edition, 2017
R2	Block Chain and Crypto Currencies, Anshul Kaushik, Khanna Publishing House, Delhi.
R3	Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, Imran Bhashir, Packt Publishing.
W1	https://www.edx.org/learn/blockchain
W2	https://www.coursera.org/courses?query=blockchain

Course Outcomes: On completion of this course, students can	
CO1	Understand block chain technology.
CO2	Develop block chain-based solutions
CO3	Write smart contract using Hyperledger Fabric and Ethereum frameworks.
CO4	Build and deploy block chain application for on premise and cloud-based architecture.
CO5	Integrate ideas from various domains and implement them.

QUANTUM COMPUTING			
Subject Code	21XXCTO50XC	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

- This course teaches the fundamentals of quantum information processing, including quantum computation, quantum cryptography, and quantum information theory.

Unit -1:Introduction to Quantum computing	**Hours**
Motivation for studying Quantum computing,, Mojor players in industry, Origin of Quantum Computing, overview of major concepts in Quantum Computing.	**08**
Unit -2 :Math Foundation for Quantum Computing	
Matrix algebra- Basic vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, dirac notation, Eigen values and Eigen vector	**10**
Unit – 3: Building Blocks for Quantum Program	
Architectures of a Quantum Computing Platform, Details of q-bit system of information representation- Block sphere, Multi-qubits states, Quantum superposition of qubits, Quantum entanglement, Useful states from quantum algorithmic perceptive, Operations on qubits, Quantum Logic gates and circuits, Programming model for a Quantum Computing Program- Steps performed on classical computer, steps performed on Quantum computer, Moving data between bits and qubits.	**10**
Unit – 4: Quantum Algorithms	
Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks	**10**
Unit – 5: Algorithms	
Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, IBM Quantum Experience, Microsoft Q, Rigetti PyQuil	**10**

Text(T) / Reference(R) Books:	
T1	Quantum Computation and Quantum Information, Michael A. Nielsen, Cambridge University Press.

R1	Quantum Computation Explained, David Mc Mahon, Wiley
W1	https://quantumcurriculum.mit.edu/
W2	https://www.coursera.org/courses?query=quantum%20computing

Course Outcomes: On completion of this course, students can	
CO1	To explain the working of Quantum computing program.
CO2	To explain architecture and program model.
CO3	Develop Quantum logic gate circuits
CO4	Develop quantum algorithm
CO5	Program Quantum algorithm on major toolkits.

VIRTUAL REALITY			
Subject Code	21XXCTO60XA	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Understand how the design of VR technology relates to human perception and cognition.
2. Discuss applications of VR to the conduct of scientific research, training, and industrial design.
3. Gain first-hand experience with using virtual environment technology, including 3D rendering software, tracking hardware, and input/output functions for capturing user data.
4. Learn the fundamental aspects of designing and implementing rigorous empirical experiments using VR.
5. Learn about multimodal virtual displays for conveying and presenting information and techniques for evaluating good and bad virtual interfaces.

Unit -1:Virtual reality and Virtual Environment	**Hours**
Introduction, Computer graphics, Real time computer graphics, flight simulation, virtual environment requirement, benefits of virtual reality, historical development of VR, scientific landmark. 3D Commuter Graphics: Introduction, virtual world space, positioning the virtual observer, perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, simple 3D modelling, Illumination models, reflection models, shading algorithms, radiosity, hidden surface removal, realism- stereographic image.	**10**
Unit -2 :Geometric Modelling	
Introduction, from 2D to 3D, 3D space curves, 3D boundary representation. Geometric transformation: Introduction, frames to reference, modelling transformations, instances, picking, flying, scaling the VE, Collision and detection. Generic VR system: Virtual environment, computer environment, VR technology- models of interaction, VR systems.	**10**
Unit – 3:Animating the Virtual Environment	
Introduction, the dynamics of numbers, linear and non-linear and non-linear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system. Physical Simulation:	**10**

Objects falling in a gravitational field, rotating wheels, elastic collisions, projectiles, simple pendulum, springs, flight dynamics of an aircraft	
Unit – 4:Human Factors	
the eye, the ear, the somatic senses. VR Hardware: Sensor hardware, head-coupled displays, acoustic hardware, integrated VR systems. VR Software: Modelling virtual world, physical simulation, VR toolkits, Introduction to VRML.	**10**
Unit – 5:VR Applications	
Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, IBM Quantum Experience, Microsoft Q, Rigetti PyQuil	**08**

Text(T) / Reference(R) Books:	
T1	Virtual Reality Systems, John Vince, Pearson Education Asia, 2007.
T2	Augmented and Virtual Reality, Anand R, Khanna Publishing House. Delhi
R1	Visualizations of Virtual Reality, Adams, Tata Mc Graw Hill, 2000
R2	Virtual Reality Technology, Grigore C. Burdea, Philippe Coieffet, Wiley Inter Science, 2nd edition, 2006.
W1	https://www.coursera.org/courses?query=virtual%20reality
W2	https://www.classcentral.com/tag/virtual-reality
Course Outcomes: On completion of this course, students can	
CO1	Understand geometric modelling
CO2	Understand Virtual environment
CO3	Study about Virtual Hardware and Software
CO4	Study about Software needed for developing virtual reality environment.
CO5	Develop Virtual Reality applications.

DATA STRUCTURES THROUGH C			
Subject Code	21XXCTO60XB	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Operations on linear data structures and their applications.
2. The various operations on linked lists.
3. The basic concepts of Trees, Traversal methods and operations.
4. Concepts of implementing graphs and its relevant algorithms.
5. Sorting and searching algorithms.

Unit -1: INTRODUCTION TO DATA STRUCTURE	**Hours**
Data Management concepts, Data types – primitive and non-primitive, Performance Analysis and Measurement (Time and space analysis of algorithms-Average, best- and worst-case analysis), Types of Data Structures- Linear & Non-Linear Data Structures. Sorting and Searching: Sorting – Bubble Sort, Selection Sort, Quick Sort, Merge Sort Searching – Sequential Search andBinary Search	**10**
Unit -2 :LINEAR DATA STRUCTURE	
Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion. Queue: Representation Of Queue, Operations On Queue, Circular Queue, Double Ended Queue, Applications of Queue.	**10**
Unit – 3: LINKED LIST	
Linked List: Singly Linked List, Doubly Linked list, Circular linked list ,Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	**08**
Unit – 4:NONLINEAR DATA STRUCTURE	

Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Binary search trees, Conversion ofGeneral Trees To Binary Trees, Applications of Trees.	**10**
Unit – 5:GRAPH, HASHING AND FILE STRUCTURES	
Graph-Matrix Representation Of Graphs, Elementary Graph operations, (Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree) Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques, File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure forindex files, hashing for direct files, Multi-Key file organization and accessmethods.	**10**

Text(T) / Reference(R) Books:	
T1	Data Structures using C -By Reema Thareja - OXFORD Higher Publication
T2	Data Structures using C & C++ -By Ten Baum Publisher – Prenctice-Hall International
R1	Fundamentals of Computer Algorithms by Horowitz, Sahni,Galgotia Pub. 2001 ed
R2	Fundamentals of Data Structures in C++-By Sartaj Sahani.
R3	Data Structures: A Pseudo-code approach with C -By Gilberg & Forouzan Publisher Thomson Learning
W1	https://www.coursera.org/specializations/data-structures-algorithms
W2	https://online-learning.harvard.edu/course/data-structures-and-algorithms

Course Outcomes: On completion of this course, students can	
CO1	Choose appropriate data structure as applied to specified problem definition.
CO2	Handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures
CO3	Apply concepts learned in various domains like DBMS
CO4	Apply concepts learned in various domains like compiler construction
CO5	Use linear and non-linear data structures like stacks, queues , linked list

DESIGNING DATABASE MANAGEMENT SYSTEMS			
Subject Code	21XXCTO60XC	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1.To introduce about database management systems

2.To give a good formal foundation on the relational model of data and usage of Relational Algebra

3.To introduce the concepts of basic SQL as a universal Database language

4.To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization

5. To provide an overview of database transactions and concurrency control.

Unit -1: Database system architecture	**Hours**
Introduction to Databases: Characteristics of the Database Approach, Advantages of using the DBMS Approach, A Brief History of Database Applications. Overview of Database Languages and Architectures: Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Users , Architecture for DBMS.	**10**
Unit -2 : E-R Models	
TheE-R Models,TheRelationalModel,IntroductiontoDatabaseDesign,DatabaseDesign and Er Diagrams, Entities Attributes, and Entity Sets, Relationship and Relationship Sets, Conceptual Design with the Er Models, The Relational Model Integrity Constraints Over Relations, Key Constraints, Foreign Key Constraints, General Constraints.	**10**
Unit - 3: Relational Algebra	
Relational Algebra, Selection and Projection, Set Operation, Renaming, Joins, Division, More Examples of Queries, Relational Calculus: Tuple Relational Calculus, Domain Relational Calculus. The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and Active Database.	**10**
Unit - 4: Normalization	

Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).	**08**
Unit - 5: Transaction Management	
Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and save point. Concurrency control for lost updates, Uncommitted data, inconsistent retrievals and the Scheduler. Concurrency control with locking methods, lock granularity, lock types, two phase locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering: Wait/Die and Wound/Wait Schemes, Database Recovery management.	**10**

Text(T) / Reference(R) Books:	
T1	In Introduction to Database Systems, CJDate, Pearson.
T2	Database Management Systems,3rdEdition,Raghurama Krishnan, Johannes Gehrke, TATAMcGrawHill.
T3	Database Systems-TheCompleteBook,H GMolina,J DUllman,J WidomPearson.
T4	Database Management Systems,6/e Ramez Elmasri, Shamkant B. Navathe, PEA
R1	DatabaseSystemsdesign,Implementation,andManagement,7thEdition,PeterRob&CarlosCoronel
R2	Database System Concepts, 5th edition, Silberschatz, Korth, TMH
R3	The Database Book Principles & Practice Using Oracle/MySQL, Narain Gehani, University Press.
W1	https://onlinecourses.nptel.ac.in/noc18_cs15/preview
W2	https://www.coursera.org/courses?query=database

Course Outcomes: On completion of this course, students can	
CO1	Understand the basic elements of a relational database management system.
CO2	Draw entity relationship and convert entity relationship diagrams into RDBMS.
CO3	Create, maintain, and manipulate a relational database using SQL.
CO4	Designs and applies normalization techniques for logical schema model.

CO5	Solves concurrent issues and problems through locking mechanism.

OPERATING SYSTEMS CONCEPTS			
Subject Code	21XXCTO70XA	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Introduce the basic concepts of operating systems, its functions and services.
2. To provide the basic concepts of process management and synchronization.
3. Familiarize with deadlock issues.
4. Understand the various memory management skills.
5. Give exposure over I/O systems and mass storage structures.

Unit -1: Operating Systems Overview	**Hours**
Computer system organization, Operating system structure, Process, memory, storage management, Protection and security, Distributed systems, Computing Environments, Open-source operating systems, OS services, User operating-system interface.	**10**
Unit -2 :System Calls & IPC	
System calls, Types, System programs, OS structure, OS generation, System Boot Process concept, scheduling (Operations on processes, Cooperating processes, Inter-process communication), Multi-threading models	**10**
Unit - 3: Process Management	
Basic concepts, Scheduling criteria, Scheduling algorithms, Thread scheduling, Multiple processor scheduling Operating system, Algorithm Evaluation, The critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Critical regions, Monitors.	**10**
Unit - 4:Memory Management & Dead lock	
System model, Deadlock characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock detection, Recovery from deadlock. Storage Management: Swapping, Contiguous memory allocation, Paging, Segmentation Virtual Memory Background, Demand paging, copy on write, Page	**10**

replacement and various Page replacement algorithms, Allocation of frames, Thrashing.	
Unit - 5:I/O Systems	
File concept, Access methods, Directory structure, Filesystem mounting, Protection, Directory implementation, Allocation methods, Free-space management, Disk scheduling, Disk management, Swap-space management, Protection.	**08**

Text(T) / Reference(R) Books:	
T1	Operating System Concepts Essentials, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, John Wiley & Sons Inc., 2010.
T2	Operating System Concepts, 9th Edition, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, John Wiley and Sons Inc., 2012
T3	Operating Systems, Second Edition, S Halder, Alex A Aravind, Pearson Education, 2016
T4	Operating Systems – Internals and Design Principles, 7th Edition, William Stallings, Prentice Hall, 2011
R1	Modern Operating Systems, Second Edition, Andrew S. Tanenbaum, Addison Wesley, 2001.
R2	Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata McGraw Hill Education, 1996.
R3	Operating Systems: A Concept-based Approach, Second Edition, D M Dhamdhere, Tata McGraw-Hill Education, 2007
R4	Operating Systems: Internals and Design Principles, Seventh Edition, William Stallings, Prentice Hall, 2011
W1	https://www.coursera.org/courses?query=operating%20system
W2	https://onlinecourses.nptel.ac.in/noc16_cs10/preview

Course Outcomes: On completion of this course, students can	
CO1	Demonstrate knowledge on Computer System organization and Operating system services.
CO2	Design solutions for process synchronization problems by using System calls and Inter process communication.
CO3	Identify the functionality involved in process management concepts like scheduling and synchronization.
CO4	Design models for handling deadlock and perform memory management.
CO5	Analyze services of I/O subsystems and mechanisms of security & protection.

R PROGRAMMING			
Subject Code	21XXCTO70XB	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Use R for statistical programming, computation, graphics, and modeling.
2. Write functions and use R in an efficient way.
3. Fit some basic types of statistical models.
4. Use R in their own research.
5. Be able to expand their knowledge of R on their own.

Unit -1: Introduction	**Hours**
How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes**.**	**08**
Unit -2 :	
R Programming Structures, Control Statements, Loops,-Looping Over Nonvector Sets,- If-Else,Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Extended Example: A Binary Search Tree.	**10**
Unit – 3: Math and Simulation in R	
Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability- Cumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /out put, Accessing the Keyboard and Monitor, Reading and writer Files	**10**
Unit – 4: Graphics	
Creating Graphs, The Workhorse of R Base Graphics, the plot() Function – Customizing Graphs, Saving Graphs to Files, Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,-ANOVA.	**10**
Unit – 5: Linear Models	

Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models- Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests	**10**

Text(T) / Reference(R) Books:	
T1	The Art of R Programming, Norman Matloff, Cengage Learning
T2	R for Everyone, Lander, Pearson
R1	R Cookbook, PaulTeetor, Oreilly
R2	R in Action, Rob Kabacoff, Manning
W1	https://www.edx.org/learn/r-programming
W2	https://www.coursera.org/learn/r-programming

Course Outcomes: On completion of this course, students can	
CO1	List motivation for learning a programming language
CO2	Access online resources for R and import new function packages into the R workspace
CO3	Import, review, manipulate and summarize data-sets in R
CO4	Explore data-sets to create testable hypotheses and identify appropriate statistical tests
CO5	Perform appropriate statistical tests using R Create and edit visualizations

PYTHON PROGRAMMING			
Subject Code	21XXCTO70XC	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Introduction to Scripting Language.
2. Exposure to various problems solving approaches of computer science.

Unit -1: Introduction	**Hours**
History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation	**08**
Unit -2 : Types, Operators and Expressions	
Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while, break, continue, pass. Data Structure**s** Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions.	**10**
Unit – 3: Functions	
Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions(Function Returning Values), Scope of the Variables in a Function - Global and Local Variables. Module**s**: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages	**10**
Unit – 4: Object Oriented Programming in Python	
Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error and Exception**s:** Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions	**10**
Unit – 5: Brief Tour of the Standard Library	
Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming,	**10**

Turtle Graphics Testing:Why testing is required?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.	

Text(T) / Reference(R) Books:	
T1	Python Programming: A Modern Approach, Vamsi Kurama, Pearson
T2	Learning Python, Mark Lutz, Orielly
R1	Think Python, Allen Downey, Green Tea Press
R2	Core Python Programming, W.Chun, Pearson
R3	Introduction to Python, Kenneth A. Lambert, Cengage
W1	https://www.coursera.org/courses?query=python
W2	https://www.edx.org/learn/python

Course Outcomes: On completion of this course, students can	
CO1	Making Software easily right out of the box
CO2	Experience with an interpreted Language
CO3	To build software for real needs.
CO4	Prior Introduction to testing software
CO5	Experience with implementation in current technologies

JAVA PROGRAMMING			
Subject Code	21XXCTO70XA	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

1. Understanding the OOP's concepts, classes and objects, threads, files, applets, swings and act.

2. This course introduces computer programming using the JAVA programming language with object-oriented programming principles.

3. Emphasis is placed on event-driven programming methods, including creating and manipulating objects, classes, and using Java for network level programming and middleware development.

Unit -1: Introduction to OOP	**Hours**
procedural programming language and object-oriented language, principles of OOP, applications of OOP, history of java, java features, JVM, program structure. Variables, primitive data types, identifiers, literals, operators, expressions, precedence rules and associativity, primitive type conversion and casting, flow of control.	**10**
Unit -2 :Classes and objects	
Classes and objects, class declaration, creating objects, methods, constructors and constructor overloading, garbage collector, importance of static keyword and examples, this keyword, arrays, command line arguments, nested classes.	**08**
Unit – 3:Inheritance	
Inheritance, types of inheritance, super keyword, final keyword, overriding and abstract class. Interfaces, creating the packages, using packages, importance of CLASSPATH and java.lang package. Exception handling, importance of try, catch, throw, throws and finally block, userdefined exceptions, Assertions	**10**
Unit – 4:Multithreading	
Introduction, thread life cycle, creation of threads, thread priorities, thread synchronization, communication between threads. Reading data from files and writing data to files, random access file.	**10**
Unit – 5:Applet	
Applet class, Applet structure, Applet life cycle, sample Applet programs. Event handling: event delegation model, sources of event, Event Listeners, adapter classes, inner classes. AWT: introduction, components and containers, Button, Label, Checkbox, Radio Buttons, List Boxes, Choice Boxes, Container class, Layouts, Menu and Scrollbar.	**10**

Text(T) / Reference(R) Books:	
T1	The complete Reference Java, 8th edition, Herbert Schildt, TMH
T2	Programming in JAVA, Sachin Malhotra, SaurabhChoudary, Oxford
R1	Introduction to java programming, 7th edition by Y Daniel Liang, Pearson
W1	https://www.coursera.org/courses?query=java
W2	https://www.udemy.com/java-tutorial/

Course Outcomes: On completion of this course, students can	
CO1	Understand Java programming concepts and utilize Java Graphical User Interface in Program writing.
CO2	Write, compile, execute and troubleshoot Java programming for networking concepts.
CO3	Build Java Application for distributed environment.
CO4	Design and Develop multi-tier applications.
CO5	Identify and Analyze Enterprise applications.

APP TECHNOLOGIES			
Subject Code	21XXCTO70XB	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

- To provide in depth knowledge and hands on experience in application development the latest trends and features.

Unit -1: Android Programming Environment	**Hours**
Android programming environment, linking activities using intents, calling built-in applications using intents.	**08**
Unit -2:User Interface	
Creating the user interface programmatically, Listening for UI notifications, build basic views, build picker views, build list views, Using image views, Using menus with views, Saving and loading user preferences	**10**
Unit – 3:Data	
Persisting data to files, Creating and using databases, Study Session, sharing data in android, Using a content provider, Creating a content provider	**10**
Unit – 4: Networking	
SMS messaging, sending emails, Networking, displaying maps, Getting location data	**10**
Unit – 5: Services	
Creating your own services, communicating between a service and an Activity, Binding Activities to Services, A complete lab work for Android service development, Deploy APK files.	**10**

Text(T) / Reference(R) Books:	
T1	Beginning Android Application Development, Wei-Meng Lee, 1st Ed, Wiley Publishing.
T2	Android: A Programmers Guide, J. F. DiMarzio, McGraw Hill Education (India) Private Limited.1st Edition.
R1	Android for Programmers: An App-Driven Approach, Paul Deitel, 1st Edition, Pearson India
R2	Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India Pvt Ltd
W1	https://www.coursera.org/browse/computer-science/mobile-and-web-development
W2	https://in.udacity.com/course/new-android-fundamentals--ud851

Course Outcomes: On completion of this course, students can	
CO1	Demonstrate their understanding of the fundamentals of Android operating systems
CO2	Demonstrate their skills of using Android software development tools
CO3	Demonstrate their ability to develop software with reasonable complexity on mobile platform
CO4	Demonstrate their ability to deploy software to mobile devices
CO5	Demonstrate their ability to debug programs running on mobile devices

WEB TECHNOLOGIES			
Subject Code	21XXCTO70XC	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

Course Objectives:

The learning objectives of this course are:

- This course is designed to introduce students with no programming experience to the programming languages and techniques associated with the World Wide Web. The course will introduce web-based media-rich programming tools for creating interactive web pages.

Unit-1: HTML	**Hours**
HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, Html media, Iframes Images, Hypertext Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML. **CSS:** Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms, The Box Model, Conflict Resolution, CSS3.	**10**
Unit -2: JSON	
Introduction to JSON: JSON, Syntax, Data Types, Schema, Security Concerns, JSON Vs XML, the JavaScript XML Http Request and Web APIs, JSON and Client-Side Frameworks, JSON and NoSQL, JSON on the server side.	**10**
Unit –3: YAML	
Introduction to YAML: YAML, Syntax, Structure, indentation in YAML documents, YAML vs JSON and XML, data types, Using advanced features like anchors in a YAML.	**10**
Unit -4: PHP	
PHP Programming: Introduction to PHP, Creating PHP script, Running PHP script. **Working with variables and constants:** Using variables, Using constants, Data types, Operators. **Controlling program flow:** Conditional statements, Control statements, Arrays, functions.	**10**
Unit – 5: Laravel	
Introduction to Laravel, Features, routing, controllers, views, Blade template, migration, Laravel Database.	**08**

Text(T) / Reference(R) Books:	
T1	Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013
T2	Web Technologies, 1st Edition 7th impression, Uttam K Roy, Oxford, 2012.
T3	Introduction to JavaScript by Lindsay Bassett, 2015.
T4	Introduction to YAML: Demystifying YAML Data Serialization Format by Tarun Telang
T5	Full-Stack Vue.Js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel
R1	Programming world wide web, Sebesta, Pearson
R2	An Introduction to web Design and Programming, Wang, Thomson
W1	https://www.edx.org/learn/web-development
W2	https://www.javatpoint.com/what-is-json
W3	https://www.javatpoint.com/yaml-scalars
W4	https://www.javatpoint.com/laravel-blade-template

Course Outcomes: On completion of this course, students can	
CO1	To develop a dynamic webpage by the use of HTML
CO2	To develop a dynamic webpage by the use of CSS
CO3	To develop a dynamic webpage by the use of JSON
CO4	To develop a dynamic webpage by the use of YML
CO5	Build web applications using PHP
CO6	To develop a dynamic webpage by the use of Laravel