CSE PG COURSE STRUCTURE

I SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20CO01	Machine Learning	3			3	40	60	100
2	20CO02	Advanced Data Structures	3			3	40	60	100
3	**PROGRAM ELECTIVE – I**		3			3	40	60	100
	20CO03	Advanced Database Management Systems							
	20CO04	Digital Image Processing							
	20CO05	Advanced Operating Systems							
4	**PROGRAM ELECTIVE – II**		3			3	40	60	100
	20CO06	Advanced Computer Networks							
	20CO07	Internet of Things							
	20CO08	Object Oriented Software Engineering							
5	20RM01	Research Methodology and IPR	2			2	40	60	100
6	AC	Audit Course-I	2			0	100	--	100
Laboratory Courses									
7	20CO61	Machine Learning with Python lab			4	2	40	60	100
8	20CO62	Advanced Data Structures Lab			4	2	40	60	100
Total			**16**	**0**	**8**	**18**	380	420	800

II SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	20CO09	Big Data Analytics	3			3	40	60	100
2	20CO10	Cryptography & Network Security	3			3	40	60	100
3	**PROGRAM ELECTIVE – III**		3			3	40	60	100
	20CO11	Neural Networks							
	20CO12	Ad-hoc & Sensor Networks							
	20CO13	Human Computer Interaction							
4	**PROGRAM ELECTIVE – IV**								
	20CO14	Cloud Computing	3			3	40	60	100
	20CO15	Pattern Recognition							
	20CO16	Software Testing and Quality Assurance							
5	AC	Audit Course-II	2			0	100	--	100
Laboratory Courses									
6	20CO63	Big Data Analytics Lab			4	2	40	60	100
7	20CO64	Cryptography & Network Security Lab			4	2	40	60	100
8	20CO51	Mini Project			4	2	100	--	100
Total			**14**	**0**	**12**	**18**	440	360	800

III SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
Theory Courses									
1	**PROGRAM ELECTIVE – V**		3			3	40	60	100
	20CO17	Computer Forensics							
	20CO18	Deep Learning							
	20CO19	Social Network Analysis							
2	OE	**Open Elective/ MOOCs**	3			3	40	60	100
Laboratory Courses									
3	20CO52	Internship			4	2	100	--	100
4	20CO53	Project Work & Dissertation (Phase-I)			16	8	40	60	100
Total			**6**	**0**	**20**	**16**	220	180	400

IV SEMESTER

S. No	Course code	Course Title	Contact hours/week			Credits	Scheme of Valuation		
			L	T	P		CIE	SEE	Total
1	20CO54	Project Work & Dissertation (Phase-II)	-	-	32	16	40	60	100
Total			**0**	**0**	**32**	**16**	40	60	100

Total Credits: 18 + 18 + 16 + 16 = 68

List of Courses offered under Audit Course

AUDIT COURSES		
S.No	**Code**	**Name of the Course**
1	20AC01	English for research paper writing
2	20AC02	Disaster Management
3	20AC03	Sanskrit for Technical Knowledge
4	20AC04	Value education
5	20AC05	Constitution of India
6	20AC06	Pedagogy Methods
7	20AC07	Stress Management by Yoga
8	20AC08	Personality Development through Life Enlightenment Skills.

List of Open Elective Courses offered to other departments

S.No	Code	Open Elective Name
1	20CO81	Advanced Computer Architecture
2	20CO82	Python Programming
3	20CO83	Introduction to Machine Learning

L	T	P	Cr.
3	-	-	3

M.Tech. (I Sem.) **20CO01-Machine Learning**

Pre-requisites: Fundamentals of Data Mining

Course Educational Objective: This course will

- Develop an appreciation for what is involved in learning from data
- Demonstrate a wide variety of learning algorithms.
- Demonstrate how to apply a variety of learning algorithms to data.
- Demonstrate how to perform evaluation of learning algorithms and model selection.

Course Outcomes: At the end of the course, the student will be able to
CO1: Understand the basic concepts of learning and decision trees.
CO2: Able to solve real world problems using Neural Networks and Genetic Algorithms.
CO3: Demonstrate on Bayesian and Computational Learning.
CO4: Analyze different types of learning and learning set of rules such as case based reasoning and learning first order rules.
CO5: Summarize various concepts of analytical learning and reinforcement learning in terms of FOCL algorithm and Q learning.

UNIT – I INTRODUCTION, CONCEPT LEARNING AND DECISION TREES Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning.

UNIT – II NEURAL NETWORKS AND GENETIC ALGORITHMS Neural Network Representation – Problems – Perceptron's – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming.

UNIT – III BAYESIAN AND COMPUTATIONAL LEARNING Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm.

UNIT – IV INSTANT BASED LEARNING AND LEARNING SET OF RULES K-Nearest Neighbour Learning – Case-Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules.

UNIT – V ANALYTICAL LEARNING AND REINFORCED LEARNING Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning.

TEXTBOOKS

1. **Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.REFERENCE**
1. EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

M.Tech. (I Sem.) **20CO02-Advanced Data Structures**

L	T	P	Cr.
3	-	-	3

Pre-requisites: Programming Language and principles of Data Structures

Course Educational Objective: From the course the student will learn

- Implementation of variety of data structures including linked lists, binary trees, heaps, graphs and search trees
- Applications of Dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Search trees.
- Operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees.

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

CO1: Write and analyze algorithms for linear data structure and check it's correctness and efficiency
CO2: Demonstrate various searching, sorting and trees & Graphs traversal techniques and be able to apply and solve problems of real life
CO3: Master a variety of advanced abstract data type (ADT) and data structures and their Implementation
CO4: Design and implement Priority Queues
CO5: Ability to compare various search trees and find solutions for IT related problems

UNIT – I: Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists- Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

UNIT – II: Searching-Linear and Binary, Search Methods,
Sorting-Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort.
Trees- Binary trees, Properties, Representation and Traversals (DFT, BFT), Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage structures and Traversals.

UNIT – III: Dictionaries, ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate Chaining, Open Addressing-Linear Probing, Double Hashing.

UNIT – IV: Priority queues- Definition, ADT, realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion. Search Trees- Binary Search Trees, Definition, ADT, Implementation**,** Operations- Searching, Insertion, Deletion.

UNIT – V: Search Trees- AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

TEXTBOOKS

1. Data Structures: A Pseudo Code Approach, 2/e, Richard F. Gilberg, BehrouzForouzon and Cengage.
2. Data Structures, Algorithms and Applications in java, 2/e, Sartaj Shani, University Press

REFERENCE

1. Data Structures and Algorithm Analysis, 2/e, Mark Allen Weiss, Pearson.
2. Data Structures and Algorithms, 3/e, Adam Drozdek,Cengage
3. C and Data Structures: A Snap Shot Oriented Treatise using Live Engineering Examples, N.B. Venkateswarulu, E.V.Prasad and S Chand & Co, 2009

M.Tech.(I Sem.) **20CO03-Advanced Data Base Management Systems**

L	T	P	Cr.
3	-	-	3

Pre-requisites: Database Systems

Course Educational Objective:

- This Subject deals with dealing data in the real world, maintaining data without any redundancy, several techniques involved in DBMS to recover the problems caused due to redundancy, storing data for quick insertion, manipulation and deletion operations in order to retrieve data from the database.
- This subject provides an introduction to multidisciplinary field of data mining, the general data features, techniques for data preprocessing, general implementation of data warehouses and OLAP, the relationship between data warehousing and other generalization methods
- The concepts of data clustering include a different method of clustering such as k-means, k- methods, db scan algorithm, role of data mining in web mining.

Course Outcomes: At the end of the course, the student will be able to
CO1: Analyze on normalization techniques.
CO2: Elaborate on concurrency control techniques and query optimization.
CO3: Summarize the concepts of data mining, data warehousing and data preprocessing strategies.
CO4: Apply data mining algorithms.
CO5: Assess various classification & cluster techniques.

UNIT – I: Introduction: Concepts and Definitions, Relational models, Data Modeling and Query Languages, Database Objects. Normalization Techniques: Functional Dependency, 1NF, 2NF, 3NF, BCNF; Multi valued Dependency; Loss-less Join and Dependency Preservation.

UNIT – II: Transaction Processing: Consistency, Atomicity, Isolation and Durability, Serializable Schedule, Recoverable Schedule, Concurrency Control, Timestamp based protocols, Isolation Levels, Online Analytical Processing,Database performance Tuning and Query optimization: Query Tree, Cost of Query, Join, Selection and Projection Implementation Algorithms and Optimization Database Security: Access Control, MAC, RBAC, Authorization, SQL Injection Attacks.

UNIT – III: Data Mining: stages and techniques, knowledge representation methods, data mining approaches (OLAP, DBMS, Statistics and ML). Data warehousing: data warehouse and DBMS, multidimensional data model, OLAP operations. Data processing: cleaning, transformation, reduction, filters and discretization with weka.

UNIT – IV:Knowledge representation: background knowledge, representing input data and output knowledge, visualization techniques and experiments with weka. Data mining algorithms: association rules, mining weather data, generating item sets and rules efficiently, correlation analysis.

UNIT – V: Classification& Clustering: 1R algorithm, decision trees, covering rules, task prediction, statistical classification, Bayesian network, instance-based methods, linear models, Cluster/2, Cobweb, k- means, Hierarchical methods. Mining real data: preprocessing data from a real medical domain, data mining techniques to create a comprehensive and accurate model of data. Advanced topics: text mining, text classification, web mining, data mining software.

TEXTBOOKS

1. **1.Fundamentals of Database Systems, RamezElmasri, Shamkant B. Navathe, Addison-Wesley,6th edition.**
2. **2.Data Mining: Concepts and Techniques, J. Han and M. Kamber, Morgan Kaufmann C.J. Date, Database Systems, Pearson, 3rd edition.**

REFERENCE

1. Principles of Distributed Database Systems, Prentice Hall, P. Valduriez, M. TamerOzsu 3rd edition- 2000
2. Database systems: Design, implementation and Management, C.M. Coronel, S. Morris, P. Rob, Boston: Cengage Learning,9thedition-2011

M.Tech. (I Sem.)	20CO04-Digital Image Processing	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Concepts of Computer Graphics

Course Educational Objective: From the course the student will learn

- Basic principles of digital image processing and their applications.
- Demonstration of Image enhancement, Image compression and Image segmentation.
- Fundamentals of Colour Image processing techniques.

Course Outcomes: At the end of the course, the student will be able to
CO1: Summarize the fundamentals of digital image processing
CO2: Apply image enhancement techniques in spatial domain
CO3: Apply color image processing techniques to improve the fidelity of images.
CO4: Analyze image compression, morphological image processing techniques for various applications.
CO5: Evaluate the methodologies for image segmentation

UNIT – I: Introduction: Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels

UNIT – II: Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods

UNIT – III: Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation

UNIT – IV: Image Compression: Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards.
Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphologic algorithms

UNIT – V: Image Segmentation: Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation

TEXTBOOKS

1. **Digital Image Processing, Rafeal C. Gonzalez, Richard E. Woods, Second Edition, Pearson Education/PHI.**

REFERENCE

1. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning.
2. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology
3. Digital Image Processing and Analysis, B. Chanda, D. DattaMajumder, Prentice Hall of India, 2003

M.Tech. (I Sem.)	20CO05-Advanced Operating Systems	L	T	P	Cr.
		3	-	-	3

Pre-requisites: concepts of Operating Systems

Course Educational Objective:

- To provide comprehensive and up-to-date coverage of the major developments in distributed Operating System, Multi-processor Operating System and Database Operating System and to cover important theoretical foundations including Process Synchronization, Concurrency, Event ordering, Mutual Exclusion, Deadlock, Agreement Protocol, Security, Recovery and fault tolerance.

Course Outcomes: At the end of the course, the student will be able to
CO1: Illustrate on the fundamental concepts of distributed operating systems, its architecture and distributed mutual exclusion.
CO2: Analyze on deadlock detection algorithms and agreement protocols.
CO3: Make use of algorithms for implementing DSM and its scheduling.
CO4: Apply protection and security in distributed operating systems.
CO5: Elaborate on concurrency control mechanisms in distributed systems.

UNIT – I: Architectures of Distributed Systems, System Architecture types, issues in distributed operating systems, communication networks, communication primitives. Theoretical Foundations, inherent limitations of a distributed system, lamp ports logical clocks, vector clocks, casual ordering of messages, global state, cuts of a distributed computation, termination detection. Distributed Mutual Exclusion, introduction, the classification of mutual exclusion and associated algorithms, a comparative performance analysis

UNIT – II: Distributed Deadlock Detection, Introduction, deadlock handling strategies in distributed systems, issues in deadlock detection and resolution, control organizations for distributed deadlock detection, centralized and distributed deadlock detection algorithms, hierarchical deadlock detection algorithms. Agreement protocols, introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, and applications of agreement algorithms. Distributed resource management: introduction-architecture, mechanism for building distributed file systems design issues, log structured file systems.

UNIT – III: Distributed shared memory, Architecture, algorithms for implementing DSM, memory coherence and protocols, design issues. Distributed Scheduling, introduction, issues in load distributing, components of a load distributing algorithm, stability, load distributing algorithm, performance comparison, selecting a suitable load sharing algorithm, requirements for load distributing, task migration and associated issues. Failure Recovery and Fault tolerance: introduction, basic concepts, classification of failures, backward and forward error recovery, backward error recovery, recovery in concurrent systems, consistent set of check points, synchronous and asynchronous check pointing and recovery, check pointing for distributed database systems, recovery in replicated distributed databases.

UNIT – IV: Protection and security, preliminaries, the access matrix model and its implementations. -safety in matrix model, advanced models of protection. Data security, cryptography: Model of cryptography, conventional cryptography modern cryptography, private key cryptography, data encryption standard public key cryptography, multiple encryptions, authentication in distributed systems.

UNIT – V: Multiprocesso**r** operating systems, basic multiprocessor system architectures, inter connection networks for multiprocessor systems, caching hypercube architecture. Multiprocessor Operating System, structures of multiprocessor operating system, operating system design issues, threads, process synchronization and scheduling. Database Operating systems: Introduction, requirements of a database operating system Concurrency control :Theoretical aspects, introduction, database systems, a concurrency control model of database systems, the problem of concurrency control, serializability theory, distributed database systems, concurrency control algorithms, introduction, basic synchronization primitives, lock based algorithms, timestamp based algorithms, optimistic algorithms, concurrency control algorithms, data replication.

TEXTBOOKS

1**. "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", Mukesh Singhal, Niranjan and G.Shivaratri, TMH, 2001**

REFERENCE

1. "Modern operating system", Andrew S.Tanenbaum, PHI,2003
2. "Distributed operating system-Concepts and design", Pradeep K.Sinha, PHI,2003
3. "Distributed operating system", Pearson education, AndrewS.Tanenbaum, 2003

M.Tech. (I Sem.)	20CO06-Advanced Computer Networks	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Concepts of Networks

Course Educational Objective: From the course the student will

- Understand the concepts of OSI Reference Model, Protocols at different layers with special emphasis on IP, TCP & UDP and Routing algorithms.
- Learn CSMA/CD, TCP/IP implementation, LANs/WANs, internetworking technologies, Routing and Addressing.
- Know the mathematical background of routing protocols.

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

CO1: Illustrate reference models with layers, protocols, and interfaces.
CO2: Demonstrate the routing algorithms, Sub netting and Addressing of IP V4andIPV6.
CO3: Analyze the transport layer protocols and how they can be used to assist in network design and implementation.
CO4: Describe the concepts Wireless LANS, WIMAX, IEEE 802.11, Cellular telephony and Satellite networks.
CO5: Describe the emerging trends in networks-MANETS and WSN

UNIT – I :Network layer**:** Network Layer design issues: store-and forward packet switching, services provided transport layers, implementation connection less services, implementation connection oriented services, comparison of virtual –circuit and datagram subnets, Routing Algorithms-shortest path routing, flooding, distance vector routing, link state routing, Hierarchical routing, congestion control algorithms: Approaches to congestion control, Traffic aware routing, Admission control, Traffic throttling, choke Packets, Load shedding, Random early detection, Quality of Service, Application requirements, Traffic shaping, Leaky and Token buckets

UNIT – II : Internetworking and IP protocols**:** How networks differ, How networks can be connected, internetworking, tunneling, The network layer in the internet,IPV4 Protocol, IP addresses, Subnets, CIDR, classful and Special addressing, network address translation (NAT),IPV6 Address structure address space, IPV6 Advantages, packet format, extension Headers, Transition from IPV4 to IPV6 , Internet Control Protocols-IMCP, ARP,DHCP

UNIT – III: Transport Layer Protocols**:** Introduction, Services, Port numbers, User Datagram Protocol: User datagram, UDP services, UDP Applications, Transmission control Protocol: TCP services, TCP features, Segment, A TCP connection, State transition diagram, Windows in TCP, Flow control and error control, TCP Congestion control, TCP Timers, SCTP:SCTP services SCTP features, packet format, An SCTP association, flow control, error control.

UNIT – IV: Wireless LANS: Introduction, Architectural comparison, Access control, The IEEE 802.11 Project: Architecture, MAC sub layer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Bluetooth Layers Other Wireless Networks: IMAX: Services, IEEE project 802.16, Layers in project 802.16, Cellular Telephony: Operations, First Generation (1G), Second Generation (2G), Third Generation (3G), Fourth Generation (4G), Satellite Networks: Operation, GEO Satellites, MEO satellites, LEO satellites.

UNIT – V : Emerging trends in Computer networks: Mobile computing: Motivation for mobile computing, Protocol stack issues in mobile computing environment, mobility issues in mobile computing, security issues in mobile networks, MOBILE Ad Hoc Networks: Applications of Ad

Hoc Networks, Challenges and Issues in MANETS, MAC Layer Issues Routing Protocols in MANET, Transport Layer Issues, Ad hoc Network Security. Wireless Sensor Networks:WSN functioning, Operating system support in sensor devices, WSN characteristics, sensor network operation, Sensor Architecture: Cluster management, Wireless Mesh Networks: WMN design , Issues in WMNs, Computational Grids, Grid Features, Issues in Grid construction design, Grid design features,P2P Networks: Characteristics of P2P Networks, Classification of P2P systems, Gnutella, BitTorrent, Session Initiation Protocol(SIP) , Characteristics and addressing, Components of SIP, SIP establishment, SIP security.

TEXTBOOKS

1. **Data communications and networking 4th edition Behrouz A Fourzan, TMH**
2. **Computer networks 4th edition Andrew S Tanenbaum, Pearson**
3. **Computer networks, Mayank Dave, CENGAGE**

REFERENCE

1. Computer networks, A system Approach, 5^{th} ed, Larry L Peterson and Bruce S Davie,Elsevier
2. Computer networks, A system Approach, 5^{th} ed, Larry L Peterson and Bruce S Davie,Elsevier

L	T	P	Cr.
3	-	-	3

M.Tech. (I Sem.) **20CO07-Internet of Things**

Pre-requisites: Fundamentals of ad-hoc networks and computer networks

Course Educational Objective:

- To understand the vision of IoT from a global context.
- To understand the application of IoT.
- To learn about various IOT-related protocols
- Use of Devices, Gateways and Data Management in IoT.

Course Outcomes: At the end of the course, the student will be able to
CO1: Summarize on the term 'internet of things' in different contexts
CO2: Understand the design principles and standards of IoT
CO3: Understand State of the Art – IoT Architecture.
CO4: Visualize the effect of IoT on smart applications
CO5: Describe the implementation of Privacy and Security in IoT

UNIT – I: IoT& Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Security, Privacy & Trust, Device Level Energy Issues.

UNIT – II:M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, M2M to IoT-An Architectural Overview– Building an architecture, Main design principles, An IoT architecture outline, standards considerations.

UNIT – III: IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT – IV : IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT – V : Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie , Security.

TEXTBOOKS

1. **VijayMadisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014.**
2. **Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013.**

REFERENCE

1. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493

M.Tech. (I Sem.)	20CO08-Object Oriented Software Design	L	T	P	Cr.
		3	-	-	3

Pre-requisites: computer programming

Course Educational Objective:

- To elicit, analyze and specify software requirements through a productive working relationship with various stakeholders of the project.
- To understand what software life cycle is, how software projects are planned and managed, types of resources involved in software development projects, risks are identified and assessed, predictions and assessments are made.
- To identify, formulate, and solve software engineering problems, including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance, and quality requirements

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

CO1: Demonstrate the various software development process models
CO2: Identify the basic components of Object oriented paradigms
CO3: Design and Plan software solutions to problems using an object-oriented strategy.
CO4: Apply the different testing strategies for delivering a quality product
CO5: Estimate the cost of constructing object-oriented software.

UNIT – I: Introduction to Software Engineering: Software, Software Crisis, Software Engineering definition, Evolution of Software Engineering Methodologies, Software Engineering Challenges. Software Processes: Software Process, Process Classification, Phased development life cycle, Software Development Process Models, Process, use, applicability and Advantages/limitations.

UNIT – II: Object oriented Paradigm, Object oriented Concepts, Classes, Objects, Attributes, Methods: and services, Messages, Encapsulation, Inheritance, Polymorphism, Identifying the elements of object model, management of object-oriented Software projects, Object Oriented Analysis, Domain Analysis, Generic Components of OOA model,OOA Process, Object Relationship model, Object Behavior Model.

UNIT – III: Object Oriented Design: Design for Object- Oriented systems, The Generic components of the OO design model, The System design process, The Object design process, Design Patterns, Object Oriented Programming.

UNIT – IV : Object Oriented testing: Broadening the view of Testing, Testing of OOA and OOD models, Object-Oriented testing strategies, Test case design for OO software, testing methods applicable at the class level, Interclass test case design.

UNIT – V : Technical Metrics for Object Oriented Systems: The Intent of Object Oriented metrics, The distinguishing Characteristics, Metrics for the OO Design model, Class-Oriented metrics, Operation- Oriented Metrics, Metrics foe Object Oriented testing, Metrics for Object Oriented projects. CASE Tools.

TEXTBOOKS

1. **Object oriented and Classical Software Engineering, 7/e, Stephen R. Schach, TMH.**
2. **Object oriented and Classical Software Engineering, Timothy Lethbridge, Robert Laganiere, TMH**
3. **Software Engineering by Roger S Pressman, Tata McGraw Hill Edition.**

REFERENCE

1. Component based software engineering: 7^{th} International symposium, ivicaCrnkovic, Springer, CBSE 2004

M.Tech. (I Sem.)	20RM01-Research Methodology And IPR	L	T	P	Cr.
		2	-	-	2

Pre-requisites: Knowledge in Engineering, English

Course Objective: To understand the research problem, to know the literature studies, plagiarism and ethics ,to get the knowledge about technical writing ,to analyse the nature of intellectual property rights and new developments and research related information and to know the patent rights

Course Outcomes: After the completion of the course, students should be able to

CO1 Analyze the research problem and its formulation.
CO2 Analyze the significance of research ethics
CO3 Apply the information technology for better tomorrow and to develop creativity.
CO4 Identify the importance of intellectual property rights to be promoted among students in general & engineering in particular
CO5 Describe the IPR protection for new and better products, and in turn brings about, economic growth and social benefits.

UNIT I- RESEARCH PROBLEM AND SCOPE FOR SOLUTION

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II- FORMAT

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT III- PROCESS AND DEVELOPMENT

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT IV- PATENT RIGHTS

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT V- NEW DEVELOPMENTS IN IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

REFERENCES

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

M.Tech.(I Sem.) **20CO61-ML with Python LAB**

L	T	P	Cr.
-	-	4	2

Pre-requisites: Fundamentals of Data Mining

Course Educational Objective:

- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice.

Course Outcomes: At the end of the course, the student will be able to
CO1: Understand the implementation procedures for the machine learning algorithms
CO2: Design Python programs for various Learning algorithms.
CO3: Apply appropriate data sets to the Machine Learning algorithms
CO4: Identify and apply Machine Learning algorithms to solve real world problems

List of Experiments

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.
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.
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.
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

L	T	P	Cr.
-	-	4	2

M.Tech.(I Sem.) **20CO62-Advanced Data Structures Lab**

Pre-requisites: **:** Programming Language and Data Structures

Course Educational Objective:

- Knowing about oops concepts for a specific problem.
- Various advanced data structures concepts like arrays, stacks, queues, linked lists, graphs and trees.

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

CO1: Identify classes, objects, members of a class and relationships among them needed for a specific problem.
CO2: Examine algorithms performance using Prior analysis and asymptotic notations.
CO3: Organize and apply to solve the complex problems using advanced data structures (like arrays, stacks, queues, linked lists, graphs and trees.)
CO4: Apply and analyze functions of Dictionary

List of Experiments (Any of the 10 experiments are required to be conducted)
Experiment 1: Write a java program to perform various operations on single linked list
Experiment 2: Write a java program for the following
Reverse a linked list
Sort the data in a linked list
Remove duplicates
Merge two linked lists
Experiment 3: Write a java program to perform various operations on doubly linked list.
Experiment 4: Write a java program to perform various operations on circular linked list.
Experiment 5: Write a java program for performing various operations on stack using linked list.
Experiment 6: Write a java program for performing various operations on queue using linked list.
Experiment 7: Write a java program for the following using stack
Infix to postfix conversion.
Expression evaluation.
Obtain the binary number for a given decimal number.
Experiment 8: Write a java program to implement various operations on Binary Search Tree Using Recursive and Non-Recursive methods.
Experiment 9: Write a java program to implement the following for a graph.
a)BFS b) DFS
Experiment 10: Write a java program to implement Merge & Heap Sort of given elements.
Experiment 11: Write a java program to implement Quick Sort of given elements.
Experiment 12: Write a java program to implement various operations on AVL trees.
Experiment 13: Write a java program to perform the following operations:
Insertion intoaB-tree b) Searching in a B-tree
Experiment 14: Write a java program to implementation of recursive and non-recursive functions to Binary tree Traversals
Experiment 15:Write a java program to implement all the functions of Dictionary (ADT) using Hashing.

M.Tech.(II Sem.) **20CO09-Big Data Analytics**

L	T	P	Cr.
3	-	-	3

Pre-requisites: Fundamentals of Cloud Computing, Data Mining

Course Educational Objective:

- To understand big data analytics as the next wave for businesses looking for competitive advantage
- To understand the financial value of big data analytics
- To explore tools and practices for working with big data
- To understand how big data analytics can leverage into a key component
- To understand how to mine the data
- To learn about stream computing

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

CO1: Analyze the big data for useful business applications
CO2: Impart theoretical knowledge related to Data Analytics
CO3: Impart theoretical knowledge related to Stream Computing
CO4: Apply data science concepts and methods to solve problems in Predictive Analytics
CO5: Learn to build and maintain reliable, scalable, distributed systems with Apache Hadoop

UNIT – I: INTRODUCTION TO BIG DATA Analytics – Nuances of big data – Value – Issues – Case for Big data – Big data options Team challenge – Big data sources – Acquisition – Nuts and Bolts of Big data. Features of Big Data - Security, Compliance, auditing, and protection - Evolution of Big data – Best Practices for Big data Analytics - Big data characteristics.

UNIT – II: DATA ANALYSIS Evolution of analytic scalability – Convergence – parallel processing systems – Cloud computing – grid computing – map reduce – enterprise analytic sand box – analytic data sets – Analytic methods.

UNIT – III: STREAM COMPUTING Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window.

UNIT – IV: PREDICTIVE ANALYTICS AND VISUALIZATION Predictive Analytics – Supervised – Unsupervised learning – Neural networks – Kohonen models – Normal – Deviations from normal patterns - Mining Frequent item sets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm –Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data Visualizations - Visual data analysis techniques.

UNIT – V: FRAMEWORKS AND APPLICATIONS IBM for Big Data – Map Reduce Framework - Hadoop – Hive - – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Hbase – Impala – Analysing big data with twitter – Big data for E-commerce .

TEXTBOOKS

1. **Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.**
2. **Colleen Mccue, "Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis", Elsevier, 2007**

3. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007. 4. AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

REFERENCE

1. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with
2. Analytics", Wiley and SAS Business Series, 2012.
3. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill, 2011.
4. Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, "Harness the Power of Big data – The big data platform", McGraw Hill, 2012. 8. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 9. Pete Warden, Big Data Glossary, O'Reilly, 2011. 10. Jiawei Han, MichelineKamber "Data Mining Concepts and Techniques", Second Edition,

M.Tech. (II Sem.)	20CO10-Cryptography and Network Security	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Principles of Computer networks, Security aspects in Internet and Data communication networks

Course Educational Objective:

- To Understand OSI security architecture and classical encryption techniques.
- To know fundamental knowledge on the concepts of finite fields and number theory. Understand various block cipher and stream cipher models.
- To learn the principles of public key cryptosystems, hash functions and digital signature.

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

CO1: Describe the key security requirements of confidentiality and integrity
CO2: Analyze the different process for hiding the information with conventional cryptographic algorithms
CO3: Analyze public cryptosystems and disseminate from conventional systems for the security
CO4: Apply authentication techniques to provide secure communication
CO5: Explore email security, web security and system security

UNIT – I: Introduction: Confidentiality -- Data Integrity -- Authentication -- Non-Repudiation. -- Overview of Issues involved. Classical Encryption Techniques: Mono alphabetic, Substitution Methods, Poly alphabetic Substation Methods -- Permutation Methods – Cryptanalysis of these Methods.

UNIT – II: Modern Encryption Techniques: Simplified DES -- DES -- Triple DES -- Block Cipher, Design Principles -- Block Cipher Modes of Operation. IDEA -- Security Issues Involved with these methods. Confidentiality Using Conventional Encryption: Placement of Encryption -- Traffic Confidentiality -- Key Distribution -- Random Number Generation.

UNIT – III: Introduction to Number Theory :(Basics Pertaining to Security Related Algorithms). Public Key Cryptography: Principles -- RSA Algorithm.

UNIT – IV: Message Authentication and Hash Functions -- Hash an MAC Algorithms. Digital Signatures and Authentication Protocols -- Authentication Applications.

UNIT – V: Basic Overview of Electronic Mail Security -- IP Security -- WEB Security.
System Security: Intruders, Viruses and Worms – Firewalls.

TEXTBOOKS

1. **Cryptography and Network Security, William Stallings. (Second Edition) Pearson Education, Asia.**

REFERENCE

1. Network Security: The Complete Reference.by Roberta Bragg, Mark Phodes-Ousley, Keith. Strasberg Tata McGraw-Hill.

L	T	P	Cr.
3	-	-	3

M.Tech. (II Sem.) **20CO11- Neural Networks**

Pre-requisites: Fundamentals of artificial intelligence

Course Educational Objective:

- To understand the basic concepts of neurons, perceptron's and back propagation networks.
- To understand feed forward and recurrent networks.
- To learn Support Vector Machines and Linear regression.
- To learn different types of unsupervised neural networks.
- To understand adaptive resonance theory and its applications.

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

CO1: Describe models of the brain and neuron function with mathematical methods.

CO2: Design and develop artificial neural networks in software.

CO3: Elaborate the Support Vector Machines for pattern recognition & Nonlinear regression

CO4: Demonstrate Unsupervised Learning Networks

CO5: Identify the Building Blocks of Adaptive Resonance

UNIT-I: Biological Neural Networks - Artificial Neuron- Activation Functions, learning rules, Hebb Network- Perceptron Networks- Adaline- Madaline-Back propagation networks, Learning factors- Linear Separability.

UNIT -II: Single Layer Feedback Networks- Hopfield Network-Associative Memories-Recurrent auto association memory –Bidirectional Associative memory-Boltzmann machine.

UNIT -III: Support Vector Machines Optimal Hyper plane for Linearly Separable Patterns and Non separable Patterns – Support Vector Machine for Pattern Recognition – XOR Problem – Support Vector Machines for Nonlinear Regression.

UNIT- IV: Unsupervised Learning Networks Neural Network based on competition - Maxnet - Hamming Network- Self-Organizing feature Maps- Learning Vector Quantization Adaptive Resonance Theory.

UNIT -V: Building Blocks of Adaptive Resonance – Substrate of Resonance Structural Details of Resonance Model – Adaptive Resonance Theory – Applications.

TEXTBOOKS

1. **LaureneFausette, "Fundamentals of Neural Networks", Pearson Education, New Delhi, 2004.**
2. **Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004.**
3. **Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2ed.,Addison Wesley Longman (Singapore) Private Limited, Delhi, 2001**.

REFERENCES

1. Limin Fu, "Neural Networks in Computer Intelligence" Tata McGraw Hill Publishing Company, New Delhi, 2006.
2. Sivanandam S N and Paul raj M, "Introduction to Artificial Neural Networks", Vikas Publishing House Private Limited, New Delhi, 2003.
3. Rajasekaran S and VijayalakshmiPai G A, "Neural Networks, Fuzzy Systems and Genetic Algorithms", Prentice Hall of India, New Delhi, 2003.

M.Tech. (II Sem.) **20CO12-Ad-Hoc & Sensor Networks**

L	T	P	Cr.
3	-	-	3

Prerequisites: Fundamentals of computer networks

Course Objectives:

- To enable student to understand fundamentals of networks, types and challenges of adhoc networks.
- To learn various adhoc routing protocols
- To understand multicast routing in adhoc networks
- To understand the transport layer issues and security protocols
- To know issues in providing QoS.

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

CO1: Explain the Fundamental Concepts and applications of ad hoc and wireless sensor networks
CO2: Enumerate the concept of routing protocols for ad hoc wireless networks
CO3: Analyze Multicast routing protocols in Ad-hoc networks
CO4: Describe the Transport layer protocols and security protocols in Ad-hoc networks
CO5: Discuss the QoS measurements and energy management issues

UNIT-1:FUNDAMENTALS Introduction – Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio Propagation Mechanisms – Characteristics of the Wireless Channel –IEEE 802.11a–b Standard – Origin of Ad hoc Packet Radio Networks – Technical Challenges – Architecture of PRNETs – Components of Packet Radios – Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet.

UNIT-II:ADHOC ROUTING PROTOCOLS Introduction – Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On–Demand Distance Vector Routing (AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) – Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) – Zone Routing Protocol (ZRP).

UNIT–III:MULTICAST ROUTING IN ADHOC NETWORKS Introduction – Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols – An Architecture Reference Model for Multicast Routing Protocols –Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy–Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing – Comparisons of Multicast Routing Protocols

UNIT-IV:TRANSPORTLAYER–SECURITY PROTOCOLS Introduction – Issues in Designing a Transport Layer Protocol for Ad hoc Wireless Networks – Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks – Other Transport Layer Protocols for Ad hoc Wireless Networks – Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and

challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad-hoc Wireless Networks

UNIT - V : QoS AND ENERGY MANAGEMENT Introduction – Issues and Challenges in Providing QoS in Ad hoc Wireless Networks –Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks Energy Management in Ad hoc Wireless Networks –Introduction – Need for Energy Management in Ad hoc Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes – System Power Management Schemes.

TEXTBOOK

1 C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", PrenticeHall,PTR,2004.

REFERENCES

1. C. K. Toh, "Ad Hoc Mobile Wireless Networks Protocols and Systems", Prentice Hall, PTR,2001.
2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000

M.Tech.(II Sem.) **20CO13-Human Computer Interaction**

L	T	P	Cr.
3	-	-	3

Pre-requisites: Knowledge of Computer and Its Architecture**.**

Course Educational Objective:

- To provide basic methodologies and processes for designing interfaces.
- To improve the interaction between users and computers by making computers more usable and receptive to the user‘s needs.
- To provide relevant principles of behavior, mostly derived from cognitive science and psychology and other sources that describe human ethologic in particular environment, especially technological ones.
- To make the students familiar with developing new interfaces and interaction techniques.

Course Outcomes: At the end of the course, the student will be able to
CO1: Identify the elements of good user interface design through effective GUI.
CO2: Describe the importance of human characteristics and understanding business functions.
CO3: Analyze screen design principles for making good decisions based on technological considerations in interface design.
CO4: Select the window, device and screen based controls through navigation schemes.
CO5: Demonstrate the basic components and interaction devices to interact with the computers.

UNIT – I: Introduction: 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

UNIT – II: Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, and understanding business junctions.

UNIT – III : 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

UNIT – IV **:** Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls.

UNIT – V **:** Components – text and messages, Icons and images – Multimedia, colour – uses, problems with choosing colours. Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.

TEXTBOOKS

1. **Wilbert O Galitz, ‖The Essential Guide to User Interface Design‖, Wiley DreamaTech, Third Edition, 2007.**

REFERENCE

1. BenShneiderman,CatherinePlaisant,**—DesigningtheUserInterface‖**,FourthEditi on,Pearson Education,2008.
2. ALAN DIX, JANET FINLAY, GREGORYD. ABOWD, RUSSELL BEALE,**—Human- Computer Interaction‖,**Third Edition,PEARSON,2009.
3. http://ps.fragnel.edu.in/~dipalis/prgdwnl/eguid.pdf
4. https://www.alljntuworld.in/download/human-computer-interaction-materials-notes/
5. http://www.crectirupati.com/sites/default/files/lecture_notes/HCI-notes.pdf

M.Tech.(II Sem.)	20CO14-Cloud Computing	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Foundations of Computer Networks and Operating System

Course Educational Objective:

- To provide knowledge on Cloud Computing concepts, technologies, and architecture.
- To introduce the concepts of Cloud Computing fundamentals, applications, and implementations.
- To identify various areas of information systems in managing the cloud environment.

Course Outcomes: At the end of the course, the student will be able to
CO1: Interpret the key dimensions of the challenge of Cloud Computing.
CO2: Explore the PAAS and SAAS Services
CO3:. Analyze the virtual machine provisioning and virtualized storage strategies.
CO4: Understand the Scientific Applications for Cloud Environments
CO5: Identify the issues in monitoring and management in cloud environment.

UNIT – I : Introduction to cloud computing- Cloud computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks.

UNIT – II: Enriching the „Integration as a Service" Paradigm for the Cloud Era--The Onset of Knowledge Era, The Evolution of SaaS, The Challenges of SaaS Paradigm, SaaS Integration Services and products, SaaS Integration Appliances. The Enterprise Cloud Computing Paradigm - Background, Enterprise Cloud Technology and Market Evolution.

UNIT – III : Infrastructure As A Service (IAAS): Virtual Machines Provisioning and Migration Services- Background and Related Work, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services ,VM Provisioning and Migration in Action, Provisioning in the Cloud Context. On the Management of Virtual Machines for Cloud Infrastructures- The Anatomy of Cloud Infrastructures, Distributed Management of Virtual Infrastructures.

UNIT – IV: Understanding Scientific Applications for Cloud Environments: A Classification of Scientific Applications and Services in the Cloud , SAGA-based Scientific Applications that Utilize Clouds. The MapReduce Programming Model and Implementations: MapReduce Programming Model, Major MapReduce Implementations for the Cloud, MapReduce Impacts and Research Directions.

UNIT – V: Managing the Cloud: Administrating the cloud, Management Responsibilities, life cycle management, cloud management products, Standards. Cloud Security: Securing the cloud, boundary, mapping, -brokered cloud storage access, storage location and tenancy, Encryption. Introducing service-oriented architecture.

TEXTBOOKS

1. **RajkumarBuyya ,JamesBroberg, AndrzejGoscinski, CLOUD COMPUTING Principles and Paradigms , Wiley Publishing inc.**
2. **Barrie Sosinsky Cloud Computing Bible, Wiley Publishing inc.**

REFERENCE

1. Michael Miller, Cloud Computing Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
2. Judith Hurwitz , Robin Bloor, Marcia Kaufman ,Fern Halper Cloud Computing for Dummies. Wiley publishing inc.
3. Cloud Application Architecture- George Reese.
4. Haley Beard Cloud computing best practices

M.Tech.(IISem.)	20CO15-Pattern Recognition	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Basic knowledge of probability &statistics, data mining

Course Educational Objective:

- To understand the concept of patterns and the basic approach to the development of pattern recognition algorithms.
- To learn methods for data pre-processing, feature extraction, and feature selection to multivariate data.
- To know supervised and unsupervised classification methods to detect and characterize patterns in real-world data.
- To develop prototype for pattern recognition algorithms that can be used to study.

Course Outcomes: At the end of the course, the student will be able to
CO1: Analyze classification problems probabilistically and estimate classifier performance
CO2: Understand the concepts of Bayesian decision theory
CO3: Apply unsupervised learning algorithms to data objects & Analyze clustering algorithms
CO4: Describe component analysis and similarity measures
CO5: Apply Hidden Markov models in real-time applications

UNIT – I: Introduction: Machine perception, pattern recognition example, pattern recognition systems, the design cycle, learning and adaptation. Bayesian Decision Theory: Introduction, continuous features – two categories classifications, minimum error-rate classification- zero–one loss function, classifiers, discriminant functions, and decision surfaces.

UNIT – II: Normal density: Univar ate and multivariate density, discriminant functions for the normal density different cases, Bayes decision theory – discrete features, compound Bayesian decision theory and context. Maximum likelihood and Bayesian parameter estimation: Introduction, maximum likelihood estimation, Bayesian estimation, Bayesian parameter estimation–Gaussian case.

UNIT – III: Un-supervised learning and clustering: Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering. Date description and clustering.

UNIT – IV : Similarity measures, criteria function for clustering. Component analyses: Principal component analysis, non-linear component analysis; Low dimensional representations and multi-dimensional scaling.

UNIT – V : Discrete Hidden Morkov Models: Introduction, Discrete–time markov process, extensions to hidden Markov models, three basic problems for HMMs
Continuous hidden Markov models: Observation densities, training and testing with continuous HMMs, types of HMMs.

TEXTBOOKS

1. **Richard O. Duda, Peter E. Hart and David G. Stroke Pattern Classifications. 2 ed Wiley Student Edition**
2. **LawerenceRabiner and Biing Hwang, Fundamentals of Speech Recognition. Pearson Education.**

REFERENCE

1. Earl Gose, Richard John Baugh and Steve Jost, Pattern Recognition and Image Analysis. PHI, 2004

M.Tech.(IISem.)	20CO16-Software Testing and Quality Assurance	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Fundamentals of Software Engineering

Course Educational Objective:

- To understand software quality assurance framework and standards.
- To understand various software quality assurance metrics and measurements.
- To know software quality assurance metrics.
- To learn software testing environment.
- To understand various software testing techniques.

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

CO1: Describe the quality assurance frame work and Quality standards
CO2: Analyze the different types of models for quality assurance
CO3: Measure various business process reengineering
CO4: Identify the mechanisms to prevent the defects
CO5: Describe risk management in software process

UNIT – I : Software Quality Assurance Framework and Standards SQA Framework: What is Quality? Software Quality Assurance, Components of Software Quality Assurance – Software Quality Assurance Plan: Steps to develop and implement a Software Quality Assurance Plan – Quality Standards: ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, MalcomBalridge, 3 Sigma, 6 Sigma

UNIT – II: Software Quality Assurance Metrics and Measurement Software Quality Metrics: Product Quality metrics, In-Process Quality Metrics, Metrics for Software Maintenance, Examples of Metric Programs.

UNIT – III: Software Quality metrics methodology: Establish quality requirements, Identify Software quality metrics, Implement the software quality metrics, analyse software metrics results, validate the software quality metrics – Software quality indicators – Fundamentals in Measurement theory.

UNIT – IV: Software Testing Strategy and Environment: Establishing testing policy, structured approach to testing, test factors, Economics of System Development Life Cycle (SDLC) Testing, Software Testing Methodology- Defects hard to find, verification and validation, functional and structural testing, workbench concept, eight considerations in developing testing methodologies, testing tactics checklist.

UNIT – V : Software Testing Techniques Black-Box, Boundary value, Bottom-up, Branch coverage, Cause-Effect graphing, CRUD,Database, Exception, Gray-Box, Histograms, Inspections, JADs, Pareto Analysis, Prototyping,Random Testing, Risk-based Testing, Regression Testing, Structured Walkthroughs, Thread
Testing, Performance Testing, White-Box Testing

TEXTBOOKS

1. **Effective Methods for Software Testing, 2nd Edition, William E. Perry, Second Edition,Wiley India, 2006**
2. **Software Quality, Mordechai Ben-Menachem/Garry S. Marliss, Thomson Learning Publication, 1997.**

REFERENCE

1. Testing and Quality Assurance for Component-based Software, by Gao, Tsao and Wu, Artech House Publishers
2. Software Testing Techniques, by BoriesBeizer, Second Edition, Dreamtech Press
3. Managing the Testing Process, by Rex Black, Wiley
4. Handbook of Software Quality Assurance, by G. Gordon Schulmeyer, James I.McManus, Second Edition, International Thomson Computer Press
5. Software Testing and continuous Quality Improvement, by William E.Lewis, GunasekaranVeerapillai, Second Edition, Auerbach Publications

M.Tech.(IISem.)	20CO63-Big Data Analytic Lab	L	T	P	Cr.
		-	-	4	2

Pre-requisites: Programming Fundamentals Java and R

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

CO1: Set up single and multi-node Hadoop Clusters
CO2: Apply Map Reduce algorithms for various algorithms
CO3: Design new algorithms that use Map Reduce to apply on Unstructured and structured data

List of Experiments

(Any of the 10 experiments are required to be conducted)

Week 1

- Downloading and installing Hadoop
- Understanding different Hadoop modes
- Startup scripts & Configuration files

Week2

- Setting up Hadoop pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux.

Week3

- After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves)

Week4

Implement the following file management tasks in Hadoop:

- Adding files and directories
- Retrieving files & Deleting files

Week5

- Implement Matrix Multiplication with Hadoop Map Reduce

Week6

- Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

Week7

- Running Word Counting on a Remote Cluster

Week 8

- K-means clustering using map reduce

Week 9

- Understanding Hive
- Installing Hive & Setting up Hive configurations
- Practice Hive with example

Week 10

- Installing HBase & thrift
- Practice HBase with example

Week 11

- Practice Importing and Exporting Data from Various DBs

Reference text

1. Big Data Analytics with R and Hadoop--VigneshPrajapati--2013 Packt Publishing

M.Tech. (II Sem.)	20CO64-Cryptography and Network Security Lab	L	T	P	Cr.
		-	-	4	2

Course Educational Objective:

- To provide deeper understanding into cryptography, its application to network security,
- threats/vulnerabilities to networks and countermeasures.
- To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality,
- Message Authentication Codes.
- To familiarize symmetric and asymmetric cryptography

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

CO1: Identify basic security attacks and services
CO 2: Use symmetric and asymmetric key algorithms for cryptography
CO 3: Make use of Authentication functions

List of Experiments

1. Implementation of Caesar Cipher technique
2. Implement the Play fair Cipher
3. Implement the Pure Transposition Cipher
4. Implement DES Encryption and Decryption
5. Implement the AES Encryption and decryption
6. Implement RSA Encryption Algorithm
7. Implementation of Hash Functions

M.Tech. (III Sem.)	20CO17-Computer Forensics	L	T	P	Cr.
		3	-	-	3

Pre-requisites: Foundations of Information Security

Course Educational Objective:

- To get the Knowledge on basic digital forensics and techniques for conducting the forensic examination on different digital devices.
- To learn the procedure for High tech Investigations, data recovery workstations.
- To know digital evidence such as the data acquisition, identification analysis.
- To familiar with forensic analysis tools to recover important evidence for identifying computer crime.

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

CO1: Understand the definition of computer forensics fundamentals
CO2: Describe the types of computer forensics technology
CO3: Illustrate the methods for data recovery, evidence collection and data seizure
CO4:.Summarize duplication and preservation of digital evidence.
CO5: Explore different computer forensics tools

UNIT – I: Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

UNIT – II: Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery workstation and software, conducting and investigations.

UNIT – III: Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

UNIT – IV: Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case
.

UNIT – V : Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

TEXTBOOKS

1. **Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.**
2. **Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics andInvestigations, 2 ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.**

REFERENCE

1. Vacca, J, *Computer Forensics, Computer Crime Scene Investigation*, 2Ed, CharlesRiver Media, 2005, ISBN: 1-58450-389.

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M.Tech. (III Sem.) **20CO18-Deep Learning**

Pre-requisites: Foundations Neural Networks

Course Educational Objective:

- Used to formalize tasks in terms of computational Complexity via Deep Learning Architectures.
- Used to design deep learning models via Statistical approaches to solve data-rich tasks
- Helpful to Build datasets, tune and train deep learning models with advanced deep learning libraries
- To understand the inner mechanisms of Deep learning Neural techniques during training
- To analyze the performance of Optimization techniques on tasks of interest

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

CO1: Design deep architectures and algorithms for pattern recognition
CO2: Analyze classification problems probabilistically and estimate classifier performance
CO3: Explore the essentials of Deep Learning and Deep Network architectures
CO4: Elaborate different types of deep learning network models
CO5: Explore the essentials of Optimization for Training Deep Models

UNIT – I: Introduction: How do we train Deep Architectures, Intermediate Representations: Sharing Features and Abstractions Across Tasks, Desiderata for LearningAI, Computational Complexity, Local vs Non-Local Generalization

UNIT – II: Probability and Information Theory: Why Probability, Random Variables, Probability Distributions, Conditional Probability, Independence and Conditional Independence, Expectation, Variance and Covariance, Information Theory, Common Probability Distributions.

UNIT – III : Neural Networks for Deep Architectures: Learning Algorithms, Generalization, Capacity, over fitting and under fitting, Generalization Error, Estimators, Bias and variance, Maximum Likelihood Estimation. Learning Mechanisms: Supervised Vs Unsupervised Learning,

UNIT – IV: Feed forward Deep learning Neural Networks: Introduction, Formalizing and Generalizing Neural Networks, Multi-Layer Neural Networks, The Challenge of Training Deep Neural Networks, Unsupervised Learning for Deep Architectures, Deep Generative Architectures, Convolutional Neural Networks, Auto-Encoders.

UNIT – V: Optimization for Training Deep Models: Optimization for Model Training: Empirical Risk minimization, generalization, Data parallelism. Challenges in Optimization: Local Minima, III- Conditions, Plateaus, Saddle Points and Other flat regions.Optimization Algorithms: Gradient Descent, Stochastic Gradient Descent, Momentum.

TEXTBOOKS

1 **Learning Deep Architectures for AI", Foundations and Trends® in Machine Learning, YoshuaBengio, 2009, Now Publishers**
2 **Deep Learning, YoshuaBengio Ian J. Goodfellow Aaron Courville, MIT Press, 2015**

REFERENCE

1. Deep Learning in Python Prerequisites The LazyProgrammer(http://lazyprogrammer.me).
2. Deep Learning and Neural Networks, Jeff Heaton, Heaton Research, Inc 2015 Statistical Language Learning, Charniack, Eugene, MIT Press, 1993.

M.Tech. (III Sem.)	20CO19-Social Network Analysis	L	T	P	Cr.
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Course Educational Objective:

- The learning objective of the course Social Network Analysis is to provide students with essential knowledge of network analysis applicable to real world data, with examples from today's most popular social networks.

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

CO 1: Demonstrate social network analysis and measures.
CO 2: Analyze random graph models and navigate social networks data
CO 3: Apply the network topology and Visualization tools.
CO 4: Analyze the experiment with small world models and clustering models.
CO 5: Compare the application driven virtual communities from social network Structure.

UNIT – I: Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily.

UNIT – II: Random graph models: Random graphs and alternative models, Models of network growth, Navigation in social Networks, Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions.

UNIT – III: Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Navigation in NetworksRevisited.

UNIT – IV: Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity, The ErdosRenyi Model, Clustering Models.

UNIT – V : Network structure -Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory, Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models.

TEXTBOOKS

1. **S. Wasserman and K. Faust. Social Network Analysis: Methods and Applications (Cambridge, Cambridge University Press, 1994)**
2. **D. Easley and J. Kleinberg, Networks, Crowds and Markets: Reasoning about a highly connected world-2010**

REFERENCE

1. Social Network Analysis: Methods and Applications (Structural Analysis in the Social Sciences) by Stanley Wasserman, Katherine Faust, 1994