Guru Nanak Dev Engineering College, Ludhiana

Department of Computer Science & Engineering

Syllabus & Scheme

M.Tech. Computer Science and Engineering
(2019 Batch Onwards)

M.Tech. Computer Science and Engineering (Scheme-2019)

Total Credits=19+17+16+16=68

SEMESTER 1

Sr. No.	Category	Course Code	Subject Name	Subject Type	Load Per Week			Marks Distribution			Credits
					L	T	P	Int.	Ext.	Total	
1	Programme Core	MCS-101	Mathematical Foundations of Computer Science	Theory	3	0	0	50	100	150	3
2	Programme Core	MCS-102	Advanced Data Structures	Theory	3	0	0	50	100	150	3
3	Programme Core	MRM-101	Research Methodology and IPR	Theory	3	0	0	50	100	150	3
4	Programme Elective	MCS-11X	Elective -1	Theory	3	0	0	50	100	150	3
5	Programme Elective	MCS-12X	Elective -2	Theory	3	0	0	50	100	150	3
6	Programme Core	LMCS-102	Advanced Data Structures Laboratory	Practical	0	0	4	50	50	100	2
7	Programme Elective	LMCS-11X	Elective -1 Laboratory	Practical	0	0	2	50	50	100	1
8	Programme Elective	LMCS-12X	Elective -2 Laboratory	Practical	0	0	2	50	50	100	1
9	Audit Course*	MAC-XXX	Audit Course	Theory	2	0	0	50	0	50	S/US
					17	**0**	**8**	**450**	**650**	**1100**	**19**
TOTAL Contact Hours: 25											

SEMESTER 2

Sr. No.	Category	Course Code	Subject Name	Subject Type	Scheme of Studies Per Week			Marks Distribution			Credits
					L	T	P	Int.	Ext.	Total	
1	Programme Core	MCS-103	Advance Algorithms	Theory	3	0	0	50	100	150	3
2	Programme Core	MCS-104	Soft Computing	Theory	3	0	0	50	100	150	3
3	Programme Elective	MCS-13X	Elective-3	Theory	3	0	0	50	100	150	3
4	Programme Elective	MCS-14X	Elective-4	Theory	3	0	0	50	100	150	3
5	Programme Core	LMCS-103	Advance Algorithms Laboratory	Practical	0	0	2	50	50	100	1
6	Programme Core	LMCS-104	Soft Computing Laboratory	Practical	0	0	2	50	50	100	1
7	Programme Elective	LMCS-XXX	Based on Electives-3	Theory	0	0	2	50	50	100	1
8	Core	LMPCS-101	Project	Practical	0	0	4	50	50	100	2
9	Audit Course*	MAC-XXX	Audit Course	Theory	2	0	0	50	0	50	S/US
					16	**0**	**6**	**450**	**600**	**1050**	**17**
TOTAL Contact Hours: 26											

SEMESTER 3

Sr. No.	Category	Course Code	Subject Name	Subject Type	Load Per Week			Marks Distribution			Credits
					L	T	P	Int.	Ext.	Total	
1	Programme Elective	MCS-15X	Elective -5	Theory	3	0	0	50	100	150	3
2	Open Elective	MOCS-XXX	Open Elective	Theory	3	0	0	50	100	150	3
3	Pre Thesis	MPTCS-101	Formulation of Research Problem	Practical	0	0	20 **($2^{\#}$+18*)**	100	100	200	10
					6	**0**	**20**	**200**	**300**	**500**	**16**
TOTAL Contact Hours: 8											

#Maximum hours for Teacher
*Independent study Hours

SEMESTER 4

Sr. No.	Category	Course Code	Subject Name	Subject Type	Load Per Week			Marks Distribution			Credits
					L	T	P	Int.	Ext.	Total	
1	Programme Core	MTCS-101	Thesis	Practical	0	0	32 **(4#+28*)**	100	200	300	16
					0	**0**	**20**	**100**	**200**	**300**	**16**
TOTAL Contact Hours: 4											

#Maximum hours for Teacher
*Independent study Hours

LIST OF ELECTIVES

List of Elective-1

Sr. No.	Course Code	Subject Name
1	MCS-111	Machine Learning
2	MCS-112	Advances in Artificial Intelligence
3	MCS-113	Wireless and Mobile Networks
4	MCS-114	Advances in Computer Networks
5	MCS-115	Advanced Operating Systems
6	LMCS-111	Machine Learning Laboratory
7	LMCS-112	Advances in Artificial Intellige nnce Laboratory
8	LMCS-113	Wireless and Mobile Networks Laboratory
9	LMCS-114	Advances in Computer Networks Laboratory
10	LMCS-115	Advanced Operating Systems Laboratory

List of Elective-2

Sr. No.	Course Code	Subject Name
1	MCS-121	Data Ware House & Data Mining
2	MCS-122	Advance Data Base System Concepts
3	MCS-123	Software Engineering Methodologies
4	MCS-124	Cloud Computing and Security
5	MCS-125	Digital Image Processing
6	LMCS-121	Data Ware House and Data Mining Laboratory
7	LMCS-122	Advance Data Base System Concepts Laboratory
8	LMCS-123	Software Engineering Methodologies Laboratory
9	LMCS-124	Cloud Computing and Security Laboratory
10	LMCS-125	Digital Image Processing Laboratory

List of Elective-3

Sr. No.	Course Code	Subject Name
1	MCS-131	Cryptography
2	MCS-132	Wireless Sensor Networks
3	MCS-133	Network Security
4	MCS-134	Data Science
5	MCS-135	Web Crawler and Search Engines
6	MCS-136	Software Testing and Quality Assurance
7	LMCS-131	Cryptography Laboratory
8	LMCS-132	Wireless Sensor Networks Laboratory
9	LMCS-133	Network Security Laboratory
10	LMCS-134	Data Science Laboratory
11	LMCS-135	Web Crawler and Search Engines Laboratory
12	LMCS-136	Software Testing and Quality Assurance Laboratory

List of Elective-4

Sr. No.	Course Code	Subject Name
1	MCS-141	Agile Software Development Approaches
2	MCS-142	Human and Computer Interaction
3	MCS-143	Natural Language Processing
4	MCS-144	Information Storage and Management
5	MCS-145	Introduction to Intelligent System
6	MCS-146	Computer Vision

List of Elective-5

Sr. No.	Course Code	Subject Name
1	MCS-151	Optimization Techniques
2	MCS-152	Social Network Analysis
3	MCS-153	Distributed Systems
4	MCS-154	Neural Networks and Fuzzy Logic
5	MCS-155	Data Preparation and Analysis
6	MCS-156	Smart Sensors and Internet of Things

List Of Open Electives offered to other Departments

Sr. No.	Course Code	Subject Name
1	MOCS-101	Simulation and Modeling
2	MOCS-102	Project Management
3	MOCS-103	Business Information System
4	MOCS-104	Human Resources Development and Training Methods
5	MOCS-105	Multimedia Communications

LIST OF AUDIT COURSES

Sr. No.	Course Code	Subject Name
1.	MAC-101	English for Research Paper Writing
2.	MAC-102	Disaster Management
3.	MAC-103	Sanskrit for Technical Knowledge
4.	MAC-104	Value Education
5.	MAC-105	Constitution of India
6.	MAC-106	Pedagogy Studies
7.	MAC-107	Stress Management
8.	MAC-108	Personality Development through Life Enlightenment Skills

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Course Code	MCS-101
Course Name	**MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE**
Credits (L-T-P)	3 (3-0-0)
Total Number of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Probability mass, density, and cumulative distribution functions, Parametric families of distributions (Binomial and Multinomial, Poisson and Normal distribution), Expected value, variance, conditional expectation, Markov and Chebyshev Inequalities ,Central Limit Theorem, Markov chains	**8**
Unit 2: Samples, populations, statistical modelling, graphical methods and data description, Random samples, sampling distributions (t-distribution and F-distribution)	**7**
Unit 3: Statistical inference, Classical Methods of estimation(Point Estimation Methods, Method of Moments and Maximum Likelihood), Statistical hypothesis: general concepts	**7**
Unit 4: Graph Theory: Isomorphism, Planar graphs, graph coloring theorem: Art Gallery problem, Hamilton circuitsand Euler cycles, Permutations and Combinations with and without repetition. Techniques to solve combinatorial enumeration problems: Binomial coefficients, Multinomial coefficients.	**7**
Unit 5: Computer science and engineering applications: Data mining, Network protocols: Resource Allocation and Congestion Control, analysis of Web traffic, Bioinformatics, Machine learning.	**7**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Develop mathematical thinking and problem solving skills associated with research and writing proofs.	C01
Get exposure to a wide variety of mathematical concepts used in computer science discipline like probability.	CO2
Use Graph Theory for solving problems.	CO3
Acquire basic knowledge of sampling and estimation.	CO4
Understand basic concepts of hypothesis.	CO5
Understand the mathematical fundamentals that are prerequisites for a variety of courses like Data Mining, Network protocols, analysis of Web traffic, Computer security, Bioinformatics and Machine Learning.	CO6

Reference Books:

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics For Engineers and Scientists, Pearson Education.
2. John Vince, Foundation Mathematics for Computer Science, Springer
3. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley.
4. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
5. Alan Tucker, Applied Combinatorics, Wiley.

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Course Code	MCS-102
Course Name	**ADVANCED DATA STRUCTURES**
Credits (L-T-P)	3(3-0-0)
Total Number of Lectures	36
Teaching Scheme	3 hours/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Hashing : Introduction, Static Hashing – Hash table, Hash Function ,overflow Handling, Dynamic Hashing Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists	**8**
Unit 2: Trees: Binary Search Trees, AVL Trees, Red Black Trees, B- Trees, B+-Trees, Splay Trees, Digital Search Trees, Finger search tree	**7**
Unit 3: Heap : Binary Heaps, d-Heaps , Leftist Heaps , Skew Heaps , Binomial Heaps , Fibonacci Heaps	**7**
Unit 4: Text Processing: Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, The Huffman Coding Algorithm , The Longest Common Subsequence Problem (LCS), Tries- Standard Tries, Compressed Tries, Suffix Tries	**7**
Unit 5 **Multidimensional Searching:** One Dimensional Range Searching, Two Dimensional RangeSearching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.	**7**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Describe the hash function and concepts of collision and its resolution methods	C01
Develop and analyze algorithms for skip lists and various types of trees.	CO2
Develop and analyze algorithms for various variations of Heaps.	CO3
Able to select a proper pattern matching algorithm for given problem.	CO4
Identify suitable data structures and develop algorithms for Multidimensional Searching	CO5
choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.	CO6

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2004.
2. Michael T Goodrich, Roberto Tamassia, Algorithm Design and Applications, John Wiley,2002.
3. Michael T Goodrich, Roberto Tamassia, Algorithm Design,Data Structures and Algorithms in C++,Second Edition John Wiley & Sons, Inc., 2011.
4. Ellis Horowitz ,Dinesh Mehta ,Sartaj Sahni ,Fundamentals of Data Structures in C++, University Press

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Course Code	MRM-101
Course Name	**Research Methodology and IPR**
Credits	3(3-0-0)
Total Number of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: 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	**6**
Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,	**6**
Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	**6**
Unit 4: 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 grantsof patents, Patenting under PCT.	**6**
Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	**6**
Unit 6: 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.	**6**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Understand research problem formulation.	CO1
Analyze research related information	CO2
Follow research ethics	CO3
Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.	CO4
Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. Field	CO5
Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	CO6

References 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, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

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Course Code	MCS-111
Course Name	**MACHINE LEARNING**
Credits	3(3-0-0)
Total No. of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction: Well defined learning problems, Defining a learning system, perspectives and issues in machine learning, the concept learning task, concept learning as search, Find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, Inductive bias	**4**
Unit 2:Supervised Learning: Basic methods: Distance based methods, Nearest- Neighbours, Decision Trees, Naive Bayes, Linear models: Linear regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and kernel Methods **Unsupervised Learning:** Clustering: k-means/ kernel k-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative models (mixture models and latent factor models)	**10**
Unit 4:Decision Tree Learning: Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, issues in decision tree learning	**4**
Unit 5:Artificial Neural Networks: Introduction, Neural network representation, appropriate problems for neural network learning, perceptrons, gradient descent and the delta rule, Adaline, Multilayer networks, Derivation of Backpropagation rule, backpropagation algorithm	**6**
Unit 6:Bayesian Learning: Introduction, Bayes theorem and concept learning, Maximum likelihood and least squared error hypothesis for predicting probabilities, minimum description length principle, Bayes optimal classifier, Naive bayes classifier, Bayesian belief networks	**6**
Unit 7:Genetic Algorithms: Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning	**6**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Learn the basics of learning problems with hypothesis and version spaces	CO1
Understand the features of machine learning to apply on real world problems	CO2
Characterize the machine learning algorithms as supervised learning and unsupervised learning and Apply and analyze the various algorithms of supervised and unsupervised learning	CO3
Analyze the concept of neural networks for learning linear and non-linear activation functions	CO4
Learn the concepts in Bayesian analysis from probability models and methods	CO5
Understand the fundamental concepts of Genetic Algorithm and Analyze and design the genetic algorithms for optimization engineering problems	CO6

Reference Books:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, First Edition.
2. Ethern Alpaydin, Introduction to Machine Learning, MIT Press, 3rd Edition.
3. Chris Bishop, Pattern Recognition and Machine Learning, Springer.
4. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2nd Edition.

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Course Code	MCS-112
Course Name	**ADVANCES IN ARTIFICIAL INTELLIGENCE**
Credits	3(3-0-0)
Total No. of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1:Introduction: An Overview of AI, Intelligent behavior, The Turing Test, Intelligent Agents: Agents and environment, concept of rationality, nature of environment, structure and architecture of agents; Markov decision processes (MDP), Software agents, Personal assistants, and Information access Collaborative agents, Information- gathering agents, Believable agents (synthetic characters, modeling emotions in agents), Learning agents, Multi-agent systems Collaborating agents, Agent teams, Competitive agents (e.g., auctions, voting).	**6**
Unit 2:Advanced Problem solving Techniques: Problem solving by Uninformed searches, Informed search and Exploration, Problem reduction and game playing: Optimal decisions in game, Alpha-Beta pruning, Two-Player perfect decision game, Imperfect Real-Time Decisions games	**6**
Unit 3: Advanced Problem Solving Paradigm and Learning: Planning, Types of planning Systems, Block World problem, Logic based planning, Linear Planning using a goal stack, Non-linear planning Strategies, Decision trees, Rule based learning, Reinforcement Learning. **Knowledge Representation:** Propositional and predicate logic, Resolution in predicate logic, Question answering, Theorem proving, Semantic networks, Frames and scripts, conceptual graphs, conceptual dependencies.	**6**
Unit 4:Reasoning under Uncertainty: Review of basic probability, Random variables and probability distributions: Axioms of probability, Probabilistic inference, Bayes' Rule, Conditional Independence, Knowledge representations using Bayesian Networks, Exact inference and its complexity, Randomized sampling (Monte Carlo) methods (e.g. Gibbs sampling), Markov Networks, Relational probability models, Hidden Markov Models, Decision Theory Preferences and utility functions, Maximizing expected utility.	**6**
Unit 5:Advanced Search: Constructing search trees, Dynamic search space, Combinatorial explosion of search space, Stochastic search: Simulated annealing, Genetic algorithms, Swarm systems and Biologically inspired models, Monte-Carlo tree search.	**6**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Understand the informed and uninformed problem types and apply search strategies to solve them.	CO1
Apply difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.	CO2
Design and evaluate intelligent expert models for perception and prediction from intelligent environment.	CO3
Formulate valid solutions for problems involving uncertain inputs or outcomes by using decision making techniques.	CO4
Demonstrate and enrich knowledge to select and apply AI tools to synthesize information and develop models within constraints of application area.	CO5
Examine the issues involved in knowledge bases, reasoning systems and planning	CO6

Reference Books:

1. Rich E., Artificial Intelligence, Tata McGraw Hills (2009) 3rd ed.
2. Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Pearson Education series, Second Edition.
3. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009) 6th ed.
4. Patterson D.W, Introduction to AI and Expert Systems, Mc GrawHill (1998), 1st ed.
5. Shivani Goel, Express Learning- Artificial Intelligence, Pearson Education Asia (2013), 1st ed.

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Course Code	MCS-113
Course Name	**WIRELESS & MOBILE NETWORKS**
Credits	3(3-0-0)
Total No. of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **Introduction:** History of different types of wireless Technologies, Wireless Networking Trends, Wireless Physical Layer Concepts, Multiple Access Technologies -SDMA, CDMA, FDMA, TDMA, Radio Propagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc.	**6**
Unit 2: **Wireless Local Area Networks:** IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF& PCF) IEEE 802.11 standards, Architecture, services, other 802.11 standards (IEEE 802.11 a,b,g,n) Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems	**6**
Unit 2: **Wireless Cellular Networks:** 1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems	**6**
Unit 3: **WiMAX:** WiMAX (Physical layer, Media Access Control, Mobility and Networking), IEEE 802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview	**6**
Unit 4: Mobile IP, Wireless Application Protocol, Adhoc Routing, Transport layer Issues in Mobile Networks: Wireless TCP	**6**
Unit 5: Wireless Sensor Networks : Introduction, Application, Physical, MAC layer and Network Layer, Power Management Bluetooth and Zigbee	**6**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
To get aware of historical development of different wireless technologies	CO1
To get familiar with key concepts of wireless networks, standards, technologies and their basic operations	CO2
To learn about various wireless local area network standard, design and analyse various medium access	CO3
To learn how to evaluate MAC and network protocols using network simulation software tools.	CO4
The students should get familiar with the wireless/mobile market and the future needs and challenges	CO5
Understand the concepts, applications of wireless sensor networks, Bluetooth and Zigbee	CO6

Reference Books:

1. Schiller J., Mobile Communications, Addison Wesley 2000
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc 2002
4. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc 2000
5. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI 200

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Course Code	MCS-114
Course Name	**ADVANCES IN COMPUTER NETWORKS**
Credits	3(3-0-0)
Total Number of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: IEEE 802.11a/b/n/g/p, 802.15, and 802.16 standards for Wireless PAN, LAN, and MAN	**5**
Unit 2: IPv6 – Header, Addressing, Neighbour Discovery, Auto-Configuration, Header Extensions and options, support for QoS, security, etc.	**6**
Unit 3: IP Multicasting: Multicast routing protocols, Virtual private network service, multiprotocol label switching	**6**
Unit 4: Overlay networks, flat routing protocols (DHTs), and peer-to-peer architectures. OSPF and BGP Routing Protocols	**6**
Unit 5: TCP Improvements and Extensions, Performance issues, TCP Congestion Control – fairness, scheduling and Delay modeling, QoS issues, differentiated services, Transport layer in Wireless Networks	**6**
Unit 6: Network Security principles, Security related issues in wireless networks, Public and Private Key Cryptography, Key distribution protocols. Digital Signatures, and digital certificates	**7**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
To develop the understanding various IEEE standards for computer networks	C01
Understanding the Internet protocol in multicasting routing protocols and routing algorithms.	CO2
To learn mechanism for overlay networks and various routing protocols	CO3
To know the multicasting and routing algorithms.	CO4
To acquire the basic network security principle including encryption algorithms	CO5
Examine the issues related to security in computer networks	CO6

Reference Books:

1. W. R. Stevens. TCP/IP Illustrated, Volume 1: The protocols, Addison Wesley, 1994.
2. G. R. Wright and W. R. Stevens. TCP/IP Illustrated, Volume 2: The Implementation, Addison Wesley, 1995.
3. W. R. Stevens. TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols, Addison Wesley, 1996.
4. W. Stallings. Cryptography and Network Security: Principles and Practice, 2nd Edition, Prentice Hall, 1998.
5. C. E. Perkins, B. Woolf, and S. R. Alpert. Mobile IP: Design Principles and Practices, Addison Wesley, 1997.
6. Hesham Soliman, Mobilie IPv6: Mobility in a Wireless Internet, Pearson Education, 2004. 7. Respective Internet Drafts and RFCs of IETF.
7. B.A. Forouzan, “Cryptography and Network Security”, Tata McGraw Hill, 2007.

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Course Code	MCS-115
Course Name	**ADVANCED OPERATING SYSTEM**
Credits	3(3-0-0)
Total No. of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 **Introduction**: Overview, Functions of an Operating System, Design Approaches, Types of Advanced Operating System - Synchronization Mechanisms, Concept of a Process, Concurrent Processes, The Critical Section Problem, Other Synchronization Problems, Axiomatic Verification of Parallel Programs - Process Deadlocks - Models of Deadlocks, Resources, System State, Necessary and Sufficient conditions for a Deadlock	**8**
Unit 2: **Processes and processors in distributed systems**: Threads, system model, processor allocation, scheduling in distributed systems: Load balancing and sharing approach, fault tolerance, real time distributed systems, Process migration and related issues.	**7**
Unit 3: **Distributed File Systems**: Introduction, features & goal of distributed file system, file models, file accessing models, file sharing semantics, file caching scheme, and file replication, fault tolerance, trends in distributed file system, case study.	**7**
Unit 4: **Distributed Shared Memory:** Introduction, general architecture of DSM systems, design and implementation issues of DSM, granularity, structure of shared memory space, consistency models, replacement strategy, thrashing	**6**
Unit 5: **Distributed Web-based Systems:** Architecture, Processes, Communication, Naming, Synchronization, Consistency and Replication: Web Proxy Caching, Replication for Web Hosting Systems, Replication of Web Applications	**7**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
List the principles of distributed systems and describe the problems and challenges associated with these principles.	C01
Understand Distributed Computing techniques, Synchronous and Processes	CO2
Apply Shared Data access and Files concepts	CO3
Design a distributed system that fulfills requirements with regards to key distributed systems properties.	CO4
Understand Distributed File Systems and Distributed Shared Memory.	CO5
Apply Distributed web-based system.	CO6

Reference Books:

1. Distributed Operating Systems Concepts and Design, Pradeep K. Sinha, PHI
2. 2 Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore,Tim Kindberg, Pearson
3. Distributed Operating Systems by Andrew S Tannebaum, Pearson
4. Distributed Computing by Sunita Mahajan & Seema Shah OXFORD
5. Distributed Systems: Principles and Paradigms by Andrew S Tanebaum, Maarten Van Steen, PHI
6. Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd Edition, Hagit Attiya and Jennifer Welch, Wiley India

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Course Code	MCS-121
Course Name	**DATA WAREHOUSING AND DATA MINING**
Credits	3(3-0-0)
Total Number of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1:Introduction to Data Warehousing and Data Mining : Data Warehouse Defined, Features of a Data Warehouse, Data Granularity, The Information Flow Mechanism, Metadata, Two Classes of Data, The Lifecycle of Data,Data Flow from Warehouse to Operational Systems, Failures of Past Decision-Support Systems, Operational Versus Decision-Support Systems, Data Warehouse v/s Data Mining, Data Mining Process, Data Mining Functionalities, Data Pre-processing – Descriptive Data Summarization, Data Cleaning, Integration and Transformation, Reduction	**6**
Unit 2:The Building Blocks of a Data Warehouse and Data Warehouse Schema: Data Warehouse Architecture Goals, Data Warehouse Architecture, Data Warehouse and Data Mart, Issues in Building Data Marts, Building Data Marts, Other Data Mart Issues, Overview of the Components, Data Warehouse Schema: The Star Schema, The Snowflake Schema, Aggregate Tables, Fact Constellation Schema or Families of Star, Keys in the Data Warehouse Schema	**6**
Unit 3:Data Warehouse Modeling and Online Analytical Processing: Building the Fact Tables and Dimension Tables, Characteristics of a Dimension Table, Characteristics of a Fact Table, The Factless Fact Table, Updates To Dimension Tables, Cyclicity of Data - Wrinkle of Time, Dimensional Modeling, Strengths of Dimensional Modeling, Data Warehouse and the Data Model, Enhancing the Data Warehouse Performance	**6**
Unit 4:Data Warehouse Design, Usage and Implementation: Data Warehouse Design Process, Data Warehouse Usage for Information Processing, Efficient Data Cube Computation, Data Cube and OLAP**,** Typical OLAP Operations, From Online Analytical Processing to Multidimensional Data Mining	**6**
Unit 5:Data Mining Techniques:A Statistical Perspective on Data Mining, Classification, Issues in Classification, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Prediction – Prediction techniques, Linear and Non-Linear Regression. Clustering: Applications of clustering, Categorization of Major Clustering Methods: Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Outlier Detection	**7**
Unit 6: **Applications and case studies:**Application of Data Warehousing (Data Visualization) and Data Mining (Web Mining) Study 1: Telecom Content Warehouse Study 2: OLAP for the Fast Food Industry Study 3: Intrusion Detection using kNN classification	**4**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Understand the evolutionary path that has led to the purpose of adapting to Data Warehouse and Data Mining techniques in various domains	CO1
Identify the need of Data Warehouse tools and techniques for designing and developing different types of databases	CO2
Compare and evaluate different Data Mining techniques for knowledge discovery	CO3
Comprehend the importance and role that Data Warehouse and Data Mining play in various fields	CO4
Describe the use of Online Analytical Processing to analyze and interpret data	CO5
Discuss various case studies to identify the needs and patterns for business domains	CO6

Reference Books:

1. Reema Thareja, “Data Warehousing”, Oxford University Press.
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts & Techniques”, Elsevier Pub.
3. Margret H. Dunham “Data Mining: Introductory and Advanced topics” Pearson Education
4. Paulraj Ponniah, “Data Warehousing Fundamentals”, John Wiley & Sons, Inc.
5. Vikram Pudi, P. Radha Krishana “Data Mining”, Oxford University press.

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Course Code	MCS-122
Course Name	**ADVANCE DATA BASE SYSTEM CONCEPTS**
Credits	3(3-0-0)
Total Number of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECT;URE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Transaction Processing and Concurrency Control: Transaction Processing concepts, techniques: Two-phase locking, Timestamp ordering, Multiversion, Validation, Multiple Granularity locking Concurrency control	**5**
Unit 2: XML Query Processing: XML query languages: XML-QL, Lorel, Quilt, XQL, XQuery, and Approaches for XML query processing, Query processing on relational structure and storage schema, XML database management system.	**4**
Unit 3:Distributed DB system concepts: Introduction, functions and architecture of a DDBMS, distributed relational database design, distributed data dictionary management, distributed transaction management, distributed concurrency control, distributed deadlock management, distributed database recovery, Distributed query optimization.	**7**
Unit 4:Web Databases: Web Technology and DBMS, Introduction, The Web as a Database Application Platform, Scripting languages, Common Gateway Interface, Extending the Web Server, Oracle Internet Platform, Semi structured Data and XML, XML Related Technologies.	**6**
Unit 5:Data Warehousing Concepts, OLAP and Data mining: Evolution of data warehousing, data warehousing concepts, ETL, Data Warehouse Design benefits and problems of data warehousing, Approaches to data mining problems, commercial tools of data mining, knowledge discovery, comparison of OLTP systems and data warehousing, On-Line Analytical Processing, Introduction to data mining.	**8**
Unit 6:Emerging Database Models, Technologies and Applications: Multimedia database, Geography databases, Gnome databases, Knowledge databases, deductive databases and semantic databases, Spatial database, Information visualization	**6**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Understand and analyze transaction processing and concurrency control	CO1
Describe how XML query are being processed and executed.	CO2
Explain the concept of distributed database architecture & design and web technology using databases.	CO3
Summarize the concepts of data warehousing, OLAP, Data mining and physical database design.	CO4
To understand the concepts of multimedia databases with the emerging technologies.	CO5
To make use of online analytical systems for the knowledge discovery.	CO6

Reference Books:

1. Database System Concepts by North, Sudarshan, Silberschatz
2. Fundamentals of database Systems by Elmasri, Navathe
3. Database Management Systems by Raghu Ramakrishnan, Gehrke
4. Database Systems: A Practical Approach to Design, Implementation and Management by Thomas Connolly, Carolyn Begg
5. Data Mining: Concepts Techniques by Han, Kamber , Pei.
6. Subramanian V.S., “Principles of Multimedia Database Systems”, Harcourt India Pvt Ltd., 2001.
7. Vijay Kumar, “Mobile Database Systems”, John Wiley & Sons, 2006

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Course Code	MCS-123
Course Name	**SOFTWARE ENGINEERING METHODOLOGIES**
Credits	3 (3-0-0)
Total Number of Lectures	36
Teaching Scheme	3 hours/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit1: Software Engineering: Software process models - Waterfall model, Iterative waterfall model, Spiral model, RAD model, Prototype model. Requirement engineering - Requirement analysis and specification, Formal and informal requirement specification, Requirement specification languages, Tools for requirements management and estimation.	**6**
Unit 2:Project Management and Scheduling: Empirical, Heuristic and analytical cost estimation Techniques. Software project scheduling: Work break down structure, Activity chart, Gantt charts, PERT charts, Project monitoring, Organization and team structures.	**6**
Unit 3:Software Design Methodologies: Function oriented design, Object oriented design, Structured analysis and design, Object oriented design methodologies, Related case studies.	**7**
Unit 4:Testing and Quality Assurance: Seven step testing process, Verification and validation, Automated static analysis, system testing, Component testing, Test case design, Test automation, Quality assurance and standards, Quality planning and control, Software reliability models.	**6**
Unit 5:Agile Software Development: The Genesis of Agile, Introduction and background, Agile Manifesto and principles, Overview of Scrum, Extreme programming, Feature driven development, Lean software development, Agile project management, Design and development practices in Agile projects, Test driven development, Continuous integration, Refactoring, Pair programming, User stories, Agile testing.	**7**
Unit 6:Software Reuse and Component Based Software Engineering: The Reuse landscape, design patterns, Application frameworks, Application system reuse, Commercial–off-the shelf component reuse, Components and component models, Component based software engineering process, Component composition, Component adaptation techniques.	**6**
COURSE OUTCOMES (CO) **On completion of course the student should be able to**	**CO#**
Demonstrate knowledge of the wider software engineering context, software engineering processes and their applicability.	CO1
Understand a problem domain and to elicit, analyze, and specify the requirements of a software system solution.	CO2
Describe and formulate test cases to perform different levels of testing	CO3
Identify and outline specific components of a software design that can be targeted for reuse.	CO4
Use the Agile process to develop a quality software product.	CO5
Analyze the engineering problems encountered in system and software development	CO6

Reference Books:

1. I. Sommerville, “Software Engineering”, Pearson Education, 2010.
2. R. S. Pressman, “Software Engineering - A Practitioner’s Approach” McGraw Hill Education (India), 2009.
3. J. R. Rumbaugh, M. R. Blaha and W. Lorensen, “Object Oriented Modeling and Design”, Prentice Hall, 1991.
4. R. Mall, “Fundamentals of Software Engineering”, Prentice Hall India, 2009.
5. B. Hughes, M. Cortell, R. Mall, “Software Project Management”, Tata McGraw Hill, 2009.

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Course Code	MCS-124
Course Name	**CLOUD COMPUTING AND SECURITY**
Credits	3(3-0-0)
Total No. of Lectures	36
Teaching Scheme	3 Lectures/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **Introduction of Computing Paradigms:** Overview of existing computing paradigms, Cluster computing, Grid computing, Utility computing, Autonomic computing, Introduction to cloud computing, Cloud computing history and evolution, Essential characteristics of cloud computing, Cloud benefits, The NIST model of cloud computing	**8**
Unit 2: **Cloud Computing Architecture:** The cloud reference model architecture, Cloud based services, Infrastructure as a service (IaaS), Platform as a service (PaaS), Software as a service (SaaS), Cloud deployment scenarios, Public cloud, Private cloud, Hybrid cloud and Community cloud	**6**
Unit 3: **Virtualization:** Virtualization, Characteristics of virtualization, Virtualization in cloud computing, Types of virtualization- Resource virtualization, Server, Storage and Network virtualization, Hypervisors. Data center- Classic data center, Virtualized data center	**7**
Unit 4: **Issues and Security:** Cloud computing issues and challenges like security, Elasticity, Service level agreement, Resource management and scheduling, Cloud security, Understanding security risks, Cloud security reference model, Encryption and key management in the cloud, Identity management.	**6**
Unit 5: **Mobile Cloud Computing:** Overview of mobile cloud computing, Advantages, Challenges, using smartphones with the cloud. Offloading techniques - their pros and cons, Mobile cloud security.	**4**
Unit 6: **Cloud Computing Platforms:** Study of recent emerging cloud computing platforms and their comparison.	**5**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
To develop an understanding of computing paradigms and compare them.	C01
To be able to choose a particular deployment model according to scenario.	CO2
Design and develop cloud and implement various services on cloud.	CO3
To develop an understating of virtualization technology and its different dimensions.	CO4
Investigate the issues and challenges in implementing cloud security and mobile cloud security.	CO5
Compare and contrast various open and proprietary cloud platforms.	CO6

Reference Books:

1. R. K. Buyya, J. Broberg and A.M.Goscinski, "Cloud Computing: Principles and Paradigms"
2. B. Sosinsky, "Cloud Computing Bible", Wiley India Pvt. Ltd.
3. M. Miller, "Cloud Computing", Que Publishing.
4. Velte, T. Velte and R. Elsenpeter, "Cloud Computing: A practical Approach", Tata McGrawHill.
5. J. Rittinghouse and J. F. Ransome, "Cloud Computing: Implementation,
6. Management, and Security", CRC Press Taylor and Francis Group.

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Course Code	MCS-125
Course Name	**DIGITAL IMAGE PROCESSING**
Credits	3(3-0-0)
Teaching Scheme	3 hours/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **Introduction:** Fundamental steps in Digital Image Processing, Components of an image processing system, Imagesampling and quantization. **Digital Image Processing Operations:** Pixel relationships and distance metrics: Image coordinate system, Image topology, Connectivity, Relations, Distance measures. Classification of image processing Operations - Arithmetic, LogicalOperations, Image interpolation Techniques (Downsampling and upsampling), Set operations, Statistical operations, Convolution and Correlation operations.	8
Unit 2: **Image Enhancement in Spatial Domain:** Image enhancement point operations: Linear and non-linear functions, Piecewise linear functions, Histogram processing. Spatial filtering - basics of filtering in the spatial domain, Smoothing linear and non-linear filters, sharpening filters.	6
Unit 3: **Image Enhancement in Frequency Domain:** Basics of filtering in the frequency domain, Image smoothing and sharpening using frequency domain filters, Homomorphic filtering. **Image Restoration:** A model of the image degradation/restoration process, Noise models, Noise filters, Degradation function.	9
Unit 4: **Multiresolution Analysis:** Wavelet analysis, Continuous wavelet transform, Discrete wavelet transform, Wavelet decomposition and reconstruction in two dimensions, Wavelet packet analysis, Wavelet based image denoising.	5
Unit 5: **Morphological Image Processing:** Structuring element, Erosion, Dilation, Opening, Closing, Hit-or-Miss transform, Boundary detection, Hole filling, connected components, Convex hull, Thinning, Thickening, Skeletons, Pruning, Reconstruction by dilation and erosion.	4
Unit 6: **Image Segmentation:** Classification of image segmentation algorithms, Point, Line and Edge detection, Hough transforms, Corner detection, Global thresholding, Otsu's method, Multivariable thresholding, Region-based segmentation,Watershed segmentation	4
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Review the fundamental concepts of a digital image processing system.	CO1
Evaluate the techniques for image enhancement and image restoration.	CO2
Analyze the utility of wavelet decompositions and their role in image processing systems.	CO3
Elucidate the mathematical modelling of image morphology.	CO4
Interpret image segmentation and representation techniques.	CO5
Design algorithms to solve image processing problems and meet design specifications.	CO6

Reference Books:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson Education, 2018.
2. S. Sridhar, "Digital Image Processing", Oxford University Press, 2016.
3. M. Sonka, V. Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", CL Engineering, 2007
4. K. R. Castleman, "Digital Signal Processing", Pearson Education, 2007.
5. R. Gonzalez and R. Woods, "Digital Image Processing Using MATLAB", McGraw Hill Education, 2017.

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Course Code	MAC-105
Course Name	**CONSTITUTION OF INDIA**
Credits	S/US
Total Number of Lectures	20
Teaching Scheme	2 hours/week

Syllabus Contents

LECTURE WITH BREAKUP	**NO. OF LECTURES**
istory of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)	**4**
hilosophy of the Indian Constitution: Preamble Salient Features	
ontours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right gainst Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional emedies, Directive Principles of State Policy, Fundamental Duties.	**4**
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	**4**
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	**4**
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	**4**
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	CO1
Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	CO2
Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.	CO3
Discuss the passage of the Hindu Code Bill of 1956.	CO4

Suggested Reading

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

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Course Code	LMCS-102
Course Name	**ADVANCED DATA STRUCTURES LABORATORY**
Credits	2(0-0-4)
Teaching Scheme	4 hours/week
List of Experiments	

LIST OF EXPERIMENTS

1. Write a program to insert, delete and traverse elements in sorted singly linked list.
2. Write a program to insert, delete and traverse elements in sorted doubly linked list.
3. Write a program to implement static hashing using linear probing as overflow technique.
4. Write a program to implement static hashing using chaining as overflow technique.
5. Write a program to implement Directory based dynamic hashing technique.
6. Write a program to implement Directoryless dynamic hashing technique.
7. Write a program to insertion and updation in skip lists.
8. Write a program to implement Boyer-Moore algorithm for String matching
9. Write a program to implement Binary Search tree.
10. Write a program to implement AVL tree.
11. Write a program to implement B tree.
12. Write a program to implement Splay tree
13. Write a program to implement Digital search tree.
14. Write a program to implement Binary heap structure.
15. Write a program to implement Leftist heaps.
16. Write a program to implement Boyer-Moore algorithm for String matching.
17. Write a program to implement Knuth-Morris-Pratt algorithm for String matching.
18. Write a program to compress text using Huffman coding algorithm.
19. Write a program to implement Tries to perform pattern matching.
20. Write a program to construct priority search tress.

COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
The student should be able to choose appropriate data structures ,understand the ADT/libraries, and useit to design algorithms for a specific problem.	CO1
Students should be able to understand the necessary mathematical abstraction to solve problems.	CO2
To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.	CO3
Student should be able to come up with analysis of efficiency and proofs of correctness.	CO4

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Course Code	LMCS-111
Course Name	**MACHINE LEARNING LABORATORY**
Credits	1(0-0-2)
Teaching Scheme	2 hours/week
List of Experiments	

LIST OF EXPERIMENTS

1. Introduction to Machine Leaning Tools.
2. 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.
3. 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.
4. 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.
5. Write a program to implement k-Nearest Neighbour algorithm to classify a standard data set. Print both correct and wrong predictions.
6. 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.
7. Develop machine learning method for classifying
   i) the incoming mails.
   ii) how people rate the movies, books, etc.
8. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Effectively use the various machine learning tools	CO1
Understand and implement the procedures for machine learning algorithms	CO2
Design Python programs for various machine learning algorithms	CO3
Apply appropriate datasets to the Machine Learning algorithms	CO4
Analyze the graphical outcomes of learning algorithms with specific datasets	CO5

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Course Code	LMCS-121
Course Name	**DATA WAREHOUSING AND DATA MINING LABORATORY**
Credits	1(0-0-2)
Teaching Scheme	2 hours/week
List of Experiments	

LIST OF EXPERIMENTS	
1 Design data warehouse for auto sales analysis 2 Design data warehouse for Student attendance analysis 3 Introduction to Weka machine learning toolkit. Create a data set (Weather or Employee table) using Weka and perform the following practicals 3.1 Apply pre-processing techniques to above data set 3.2 Normalise the above data set 3.3 Demonstrate performing association rule mining on above data set 3.4 Construct Decision tree for the above data set and classify it 3.5 Demonstrate performing regression on above data set 3.6 Demonstrate performing classification on above data set 3.7 Demonstrate performing clustering on above data set 3.8 Write a procedure for visualisation on above data set	
COURSE OUTCOMES **On completion of course the student should be able to**	**CO#**
Design Data Warehouses to solve real world problems	CO1
Assess the raw input data, and process it to provide suitable input for a range of data mining algorithms	CO2
Discover and measure intersting patterns from different kinds of databases	CO3
Evaluate and select appropriate data mining algorithms and apply, and interpret and report the output appropriately	CO4
Understand and deploy appropriate classification and clustering techniques	CO5
Implement the Data Mining techniques to conceptualize a Data Mining solution to a practical problem	CO6

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Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-103
Subject Name: ADVANCE ALGORITHMS

Programme:M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**30%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Core

Prerequisites: Introduction to algorithms, Data Structures
Additional Material Allowed in ESE:NIL
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Develop a sound theoretical understanding of advanced algorithms and practical problem solving skills.
2.	Explore wide range of advanced algorithm design techniques including dynamic programming, greedy methods, flow networks and approximation algorithms.
3.	Analyze various complexity measures (e.g., running time, disk space) to compute the complexity/performance of different algorithms.
4.	Investigate advanced issues related to design and analysis techniques of algorithms and their relation to NP-complete problems.
5.	Determine the most suitable algorithm for any given task and then apply it to the given problem.

Detailed Contents:

UNIT-I **09 hours**

Introduction to analysis of algorithms: Review of various sorting algorithms, Asymptotic Notation, Performance analysis, space and time complexity.

Fundamental Techniques: Divide and Conquer, Greedy Method, Dynamic Programming. Graphs: Definitions and Elementary Algorithms- Shortest path by Breadth First Search, Depth First Search and computation of strongly connected components, shortest path in edge weighted case (Dijkstra's Algorithm), correctness proof of Dijkstra's algorithm, Directed Acyclic Graphs -Topological sorting.

UNIT-II **09 hours**

Dynamic Programming: Elements of dynamic programming, Applications of dynamic programming – Rod cutting problem, Bellman-Ford algorithm and Floyd-Warshall algorithm for shortest path in graphs.

Greedy Algorithms: Introduction to greedy algorithms, Elements of greedy strategy, Prim's and Kruskal's algorithm for minimum spanning tree, Introduction to Matroids.

UNIT-III **11 hours**

Flow Networks and Matching: Definitions of Flow networks and flows, Ford-Fulkerson method to compute maximum flow, Max-flow min-cut theorem, Edmonds-Karp algorithm, Maximum bipartite matching problem, Push-relabel algorithm.

String Matching: Naive string matching algorithm, Rabin-Karp algorithm, Longest Common Subsequence (LCS), Knuth-Morris-Pratt pattern searching algorithm, String matching with finite automata.

UNIT-IV **07 hours**

NP-Completeness and Approximation Algorithms: Introduction to NP, NP- hard and NP-complete problems, polynomial-time verification, proof of NP-completeness. Vertex-cover problem and Traveling-Salesman problem.

Case study: Case study on recent trends in problem solving paradigms using searching and sorting by applying data structures.

Text Books:

1. Cormen T.H., Leiserson C.E., RivestR.L.,Introduction to Algorithms, PHI.
2. SanjoyDasgupta, Christos H. Papadimitriou and Umesh V. Vazirani, Algorithms, Tata McGraw-Hill.

Reference Books:

1. Horowitz E., Sahni S., RajasekaranS.,Computer Algorithms, Galgotia Publications.
2. Aho A.V., Hopcroft J.E. Ullman J.D.,The Design and Analysis of Computer Algorithms, Pearson Education Asia.
3. Knuth D.E., The Art of Computer Programming Volume 1 (Fundamental Algorithms), Narosa Publishing House.
4. Knuth D.E., The Art of Computer Programming Volume 3 (Sorting and Searching),Addison-Wesley.

E-Books and online learning material

1. Algorithms by Shai Simonson
   http://www.aduni.org/courses/algorithms/index.php?view=cw Accessed on Nov 15, 2019.
2. Advanced Algorithms by Shushi Chawla
   http://www.freebookcentre.net/CompuScience/free-computer-algorithm-books.html Accessed on Nov 15, 2019

Online Courses and video lectures

1. https://freevideolectures.com/course/3747/advanced-algorithms-cs224
2. http://www.openculture.com/2017/12/advanced-algorithms-a-free-course-from-harvard-university.html
3. https://www.coursera.org/learn/advanced-algorithms-and-complexity

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-104
Subject Name: SOFT COMPUTING

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**30%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 150	**Course Status:** Core

Prerequisites: Artificial and Neural Networks
Additional Material Allowed in ESE:NIL

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Develop intelligent systems leveraging the paradigm of soft computing techniques.
2.	Implement, evaluate and compare solutions by various soft computing approaches for finding the optimal solutions.
3.	Recognize the feasibility of applying a soft computing methodology for a particular problem
4.	Design the methodology to solve optimization problems using fuzzy logic, genetic algorithms and neural networks.
5.	Design hybrid system to revise the principles of soft computing in various applications

Detailed Contents:

UNIT-I **6 hours**

Introduction: Introduction to Soft Computing, Historical Development, Definitions, advantages and disadvantages, Hard computing vs soft computing, Applications of soft computing.

UNIT-II **8 hours**

Neural Networks: Model of an artificial neuron, Comparison of artificial neural network and biological neural network, Neural network architectures, Learning methods, Activation functions, Perceptron, Hopfield network, Back-propagation network, Radial basis function network, **Competitive Neural Nets**- Kohonen self-organizing feature maps, Learning Vector Quantization (LVQ), Adaptive Resonance Theory (ART)

UNIT-III **8 hours**

Fuzzy Logic: Concept of fuzziness, Fuzzy vs crisp, Crisp sets, Operations on crisp sets, Properties of crisp sets, Fuzzy sets, Features of fuzzy sets, Basic fuzzy set operations, Properties of fuzzy sets, Fuzzy relations, Fuzzy membership functions, linguistic hedges, Fuzzy rule-based system, De-fuzzification methods, Fuzzy extension principle

UNIT-IV **14 hours**

Genetic Algorithms and Multi-objective Optimization: Concept of **n**atural evolution, Generation of population, Encoding, Fitness Function, Reproduction, Crossover, Mutation, probability of crossover and probability of mutation, convergence. Concept of multi-objective optimization problems (MOOPs), Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

Text Books:

1. V. Kecman, 'Learning and Soft Computing", MIT Press.
2. S. Haykin, "Neural Networks. A comprehensive Foundation", Prentice Hall.
3. D.E. Goldberg, "Genetic Algorithms in Search and Optimization, and Machine Learning", Addison-Wesley.

Reference Books:

1. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Wiley India.
2. S. Rajasekaran and G.A.V. Pai, "Neural Networks, Fuzzy logic and Genetic Algorithms", Prentice Hall of India.
3. Xin-She Yang , "Nature-Inspired Metaheuristic Algorithms", Luniver Press.

E-Books and online learning material

1. Applications of Soft Computing by
https://www.springer.com/gp/book/9783540896180 Accessed on 14th December,2019.

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106/105/106105173/ Accessed on 14th December,2019.
2. https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.htmlAccessed on14th December,2019.

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS - 131
Subject Name: CRYPTOGRAPHY

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**30%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 150	**Course Status:** Elective-3

Prerequisites: Computer Networks
Additional Material Allowed in ESE: Scientific Calculator

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Identify and analyze network security attacks and counter measures to prevent those attacks.
2.	Analyze the applications of discrete mathematics and understand their implementation in cryptography.
3.	Apply the knowledge of existing encryption and decryption techniques to provide security solutions.
4.	Assess impact of public key cryptosystems and key management to ensure secure exchange of information.
5.	Investigate the security requirements and solutions for maintaining Data integrity using modern techniques for data transmission.

Detailed Contents:

UNIT-I **09 hours**

Introduction to Security: Need for security, Security Services and Mechanisms, Principles of security, Types of attacks, Intruders, Malicious software, Viruses and related threats, Counter measures, Steganography, Applications

Mathematics of Cryptography: Integer Arithmetic, Euclidean Algorithm, Modular Arithmetic, Matrices, Linear Congruence, Algebraic Structures: Group, Ring, Field, GF(2^n) Fields. Primes, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation and Logarithm. .

UNIT-II **09 hours**

Classical Encryption Techniques: Encryption, Decryption, Plaintext, Cipher text, Key range and Size,Symmetric cipher model, Asymmetric cipher model, Substitution techniques, Transposition techniques, Feistel networks, Block cipher– DES, Triple DES, AES. Stream ciphers – RC4.

UNIT-III **11 hours**

Public Key Cryptography and RSA: Principles of public key cryptosystems, Diffie Hellman key exchange, RSA algorithm and its attacks, Key management – Needham Schroeder protocol, Otway-rees protocol.

Authentication and Key Management: Entity Authentication – Password based authentication, Challenge-response protocols, Biometrics. Symmetric Key Distribution and Management, Public-key Distribution, Kerberos.

UNIT-IV **07 hours**

Integrity: Message Integrity, Hash Function, Message Authentication -MAC, HMAC. MD5 algorithm, Secure Hash Algorithm, Public Key Infrastructure, Digital Signature, Digital Signature Standard algorithm, Attacks on digital signature.

Text Books:

1. Behrouz A. Forouzan, "Cryptography & Network Security", McGraw-Hill Education.
2. AtulKahate, "Cryptography & Network Security", Tata Mc Graw Hill.
3. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education.

Reference Books:

1. Wenbo Mao, "Modern Cryptography: Theory and Practice", Hewlett-Packard Company.
2. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, "Handbook of Applied Cryptography", CRC Press.

E-Books and online learning material

1. Modern Cryptography by P. Rogaway
   https://web.cs.ucdavis.edu/~rogaway/classes/227/winter00/ Accessed on Dec.17, 2019
2. A Graduate Course in Applied Cryptography by Dan Boneh and Victor Shoup
   https://crypto.stanford.edu/~dabo/cryptobook/draft_0_2.pdf Accessed on Dec.17, 2019
3. Lecture Notes on Cryptography by S. Goldwasser and M. Bellare
   http://cseweb.ucsd.edu/~mihir/papers/gb.pdf Accessed on Dec.17, 2019

Online Courses and Video Lectures

1. https://crypto.stanford.edu/~dabo/courses/OnlineCrypto/ Accessed on Dec 18, 2019
2. https://nptel.ac.in/courses/106/105/106105031/ Accessed on Dec 18, 2019
3. https://nptel.ac.in/courses/106/105/106105162/ Accessed on Dec 18, 2019
4. https://www.slideshare.net/ayyakathir/cryptography-and-network-security-52030354
   Accessed on Dec 18, 2019

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS – 132
Subject Name: WIRELESS SENSOR NETWORKS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**10%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 150	**Course Status:** Elective-3

Prerequisites: Computer Networks
Additional Material Allowed in ESE:NIL

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Know the basics of Ad hoc networks and Wireless Sensor Networks
2.	Analyze the sensor node architecture, and its operating
3.	Apply the knowledge to identify appropriate physical and MAC layer protocols
4.	Design and apply suitable routing algorithm based on the network and user requirement
5.	Be familiar with the transport layer protocols sensor networks.

Detailed Contents:

UNIT-I **10 hours**

Introduction to Wireless Sensor Networks:
Motivation, key features of Adhoc networks. Wireless sensor network: features, design Challenges and constraints; Applications of wireless sensor networks. Overview of wireless sensor network: Design Issues in sensor networks, Sensor network architecture: ADC, Processor Subsystem, Communication Interfaces, Prototypes, Operating System

Basic Wireless Sensor Technology: Introduction, Sensor Node Technology: hardware and software, Wireless sensor taxonomy

UNIT-II **10 hours**

Physical Layer: Overview of Basic Components, Source Encoding, Channel Encoding, Modulation, Signal Propagation

MAC Protocols: Fundamentals of MAC protocols, Wireless MAC protocols, Characteristics of MAC protocols in sensor networks, Contention free MAC protocols, Contention Based MAC protocols, Hybrid MAC protocols

UNIT-III **10 hours**

Routing Protocols: Issues in designing a routing protocol, Flooding and gossiping, Data dissemination and gathering, classification of routing protocols:Data centric routing, table-driven, on-demand, hybrid, hierarchical, location based and QoS routing

UNIT-IV **06 hours**

Transport protocols: Traditional transport protocols, Transport protocols for sensor networks..

Text Books:

1. Fundamentals of Wireless Sensor Networks: Theory and Practice, WaltenegusDargie and Christian Poellabauer, Wiley Series on Wireless Communication and Mobile Computing
2. K. Sohraby, D. Minoli and T. Znati, "Wireless Sensor Networks: technology, Protocols and Applications" Wiley Publications

Reference Books:

1. Feng Zhao and LeonidesvGuibas, "Wireless sensor networks ", Elsevier publication
2. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education

E-Books and online learning material

1. Wireless Sensor Networks by KazemSohraby, Daniel Minoli and TaiebZnati http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02 Accessed on Dec.24, 2019
2. An Introduction to Wireless Sensor Networks by Carlo Fischione https://www.kth.se/social/files/5431a388f276540a05ad2514/An_Introduction_WSNS_V1.8.pdf Accessed on Dec.24, 2019

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106105160/ Accessed on Dec 24, 2019
2. https://www.udemy.com/course/hands-on-wireless-sensor-networks-with-esp32/ Accessed on Dec 24, 2019
3. https://www.classcentral.com/course/swayam-wireless-ad-hoc-and-sensor-networks-7888 Accessed on Dec 24, 2019

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-133
Subject Name:NETWORK SECURITY

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**30%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-3

Prerequisites: Fundamentals ofCryptography
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Examine the concepts related to fundamentals of cryptography including symmetric cryptography, asymmetric cryptography, and digital signatures.
2.	Identify the Authentication requirements and functions for security over the network.
3.	Design and Analyse various Algorithms for ensuring Authentication.
4.	Predict various TCP/IP security mechanisms to maintain wireless network Security.
5.	Analysis Email security, Web security and Predict various recent trends of security protection over the network.

Detailed Contents:

UNIT-I **08hours**

Overview of Network Security: Basic concepts: confidentiality, integrity, availability, security policies, security mechanisms, assurance, Review of Cryptography: Secret key Cryptography, Public Key Cryptography,Encrypting large messages (ECB, CBC, OFB,CFB, CTR), Examples DES, RSA. Message Digests: Applications, Strong and weak collision resistance, The Birthday Paradox, MD5, SHA-1

UNIT-II **10 hours**

Authentication: Security Handshake pitfalls, Online vs. offline password guessing, Reflection attacks, Per-session keys and authentication tickets, Key distribution centers and certificate authorities.

Trusted Intermediaries: Public Key infrastructures, Certification authorities and key distribution centers, Kerbero

UNIT-III **08 hours**

Network security: Firewalls, Network intrusion detection, Transport security: Mechanisms of TLS, SSL, IPSec: IPsec: AH and ESP, IPsec: IKE

UNIT-IV **10 hours**

Electronic Mail Security: Distribution lists, Establishing keys, Privacy, source authentication, message integrity, non-repudiation, proof of submission, proof of delivery, message flow confidentiality, anonymity, Pretty Good Privacy (PGP) S/MIME

Web Security: SQL injection, XSS, etc. Software security and buffer overflow Malware types and case studies.

Other Topics: Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication. Recent trends in IOT security, IDS and Biometric.

Text Books:

1. C. Kaufman, R. Perlman amd M. Speciner, "Network Security Private Communication in Public World", PHI Learning Private Limited
2. W. Stallings, "Cryptography and Network Security: Principles and Practice" Prentice Hall
3. W. Stallings, "Network Security Essentials: Applications and Standards"PearsonPublications
4. R. Bragg, M. P. Ousley and K.Strassberg, "The Complete Reference:Network Security", Tata McGraw-Hill

Reference Books:

1. Yang Xiao and Yi Pan, "Security in Distributed and Networking Systems", World Scientific
2. Aaron E. Earle, "Wireless Security Handbook", Auerbach publications, Taylor & Francis Group
3. E. Maiwald, "Fundamentals of Network Security", Mc-Graw Hill Education

E-Books and online learning material

1. Computer Network Security by Jie Wang
   https://epdf.pub/queue/computer-network-security-theory-and-practice.html#
   Accessed on Dec.18, 2019
2. Network Security, Administration and Management: Advancing Technology and Practice by Dulal Chandra Kar and Mahbubur Rahman Syed
   https://epdf.pub/network-security-administration-and-management-advancing-technologies-and-practi.html Accessed on Dec. 20, 2019
3. Network and Security System by John R. Vacca
   https://epdf.pub/network-and-system-security.html
   Accessed on Dec. 23, 2019

Online Courses and Video Lectures

1. https://swayam.gov.in/nd1_noc20_cs21/preview Accessed on Dec.17, 2019
2. https://nptel.ac.in/courses/106/105/106105162/Accessed on Dec.18, 2019
3. https://nptel.ac.in/courses/106/105/106105031/ Accessed on Dec. 18, 2019
4. https://www.studytonight.com/computer-networks/comparison-osi-tcp-model Accessed on Dec.23, 2019
5. https://www.studytonight.com/computer-networks/connection-oriented-and-connectionless-service Accessed on Dec.23, 2019

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-134
Subject Name:DATA SCIENCE

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**10%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-3

Prerequisites: Data Bases
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Use the core concepts and technologies of data science for data collection, management and data storage
2.	To be able to apply various data analysis techniques on data sets.
3.	To examine the various data visualization types and identify the type to be applied.
4.	To investigate the applications of data science in various domains.
5.	To examine recent trends in data collection and analysis techniques.

Detailed Contents:

UNIT-I **10 hours**

Introduction of Data Science and Data Collection: Introduction to core concepts and technologies, Terminology, Data science process, Data science toolkit, Types of data, Example applications. Sources of data, Data collection and APIs, Data cleaning, Exploring and fixing data, Data storage and management, Using multiple data sources.

UNIT-II **10 hours**

Data Analysis: Introduction to Data Analysis, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, Logistic regression, K-Means, SVM, Naive Bayes

UNIT-III **08 hours**

Data Visualisation: Introduction to Data Visualisation, Types of Data visualization (Temporal, Hierarchical, Network, Multidimensional, Geospatial), Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings

UNIT-IV **08 hours**

Applications and Recent Trends in Data Science: Applications of Data Science, Technologies for visualization, Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1,

Reference Books:-

1. Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1stEdition, AmbigaDhiraj, Wiely CIO Series, 2013.
2. JyLiebowitz, "Big Data and Business analytics",CRC press, 2013
3. EMC Education Services "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley.

Online sources:-

1. https://www.coursera.org/search?query=data%20science
2. https://cognitiveclass.ai/
3. https://www.edx.org/course/subject/data-science
4. https://nptel.ac.in/courses/106106179/

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-135
Subject Name:WEB CRAWLER AND SEARCH ENGINES

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:20%**
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-3

Prerequisites: Web Technology
Additional Material Allowed in ESE: Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Explain fundamental concepts related to architecture of search engines and web crawlers.
2.	Identify and explain the output of search engines in the context of web searching.
3.	Categorize ranking and indexing algorithms and their limitations.
4.	Design a search engine architecture based on input design requirements.
5.	Prioritize the use of high performance computing in the design of a Web search infrastructure.

Detailed Contents:

UNIT-I **10 hours**

Web Crawling: Web search overview, Web structure, Crawling the Web, Directory Crawling, Web size measurement, Crawling and web indexes, Near-duplicate detection, Link analysis, Learning to rank, Focused web crawler and its different architectures.

Introduction to Search Engines: Search engines, Characteristics of Search engines, Search Engine Functionality, Search Engine Architecture, Ranking of web pages, The search engine history, Enterprise Search, Enterprise Search Engine Software

UNIT-II **08 hours**

Ranking Techniques: Ranking Models, Inverted indexes, Documents, Counts,Positions, Fields and Extents, Scores, Ordering, Compression, Entropy and Ambiguity, Delta Encoding, Bit-aligned codes, Byte-aligned codes, Looking ahead.

Search Engine Evaluation: The Evaluation Corpus, Logging, EffectivenessMetrics, Recall and Precision, Averaging and Interpolation, Focusing On the Top Documents, Using Preferences,

Efficiency Metrics, Training, Testing, and Statistics, Significance Tests, Setting Parameter Values, Bottom Line.

UNIT-III **09 hours**

Classification and Categorization: Introduction toClassification and Categorization, Naive Bayes, SupportVector Machines, Evaluation, Classifier and Feature Selection, Spam, Sentiment, and Online Advertising.

UNIT-IV **09 hours**

Clustering: Forms of clustering, Hierarchical and *K*-Means Clustering, *K*-Nearest Neighbour Clustering, Social Search, User Tags and Manual Indexing, Searching With Communities, Filtering and, Recommending, Document Filtering, Collaborative Filtering, Personalization, Peer-to-Peer and Meta search, Distributed search.

Text Books:

1. Christopher D. Manning, PrabhakarRaghavan, and HinrichSchutze, 'Introduction to Information Retrieval",Cambridge University Press.
2. W.B. Croft, D. Metzler, T. Strohman,"Searchengines",Pearson Education, Inc.
3. GeradusBlockdyk,"Web crawler Standard Requirements",5STARCooks.

Reference Books:

1. SoumenChakrabarti, Mining the Web, 1st Edn., Morgan-Kaufman
2. R. B. Yate and B. R. Neto, "Modern Information Retrieval", Pearson Education

E-Books and Online Learning Material

1. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjkprPt7IfnAhVVWH0KHRmnA5IQFjAAegQIBBAB&url=https%3A%2F%2Fciir.cs.umass.edu%2Fdownloads%2FSEIRiP.pdf&usg=AOvVaw1uA0WKXha71IUMAIvRHNlw
2. https://www.oncrawl.com/oncrawl-seo-thoughts/8-free-ebooks-to-improve-your-seo-knowledges/
3. https://www.searchenginejournal.com/search-engines/crawling-indexing/#close

Online Courses and Video Lectures

1. https://freevideolectures.com/course/2308/internet-technology
2. https://www.udemy.com/course/building-a-search-engine/
3. https://www.youtube.com/watch?v=JjywDlY1OJk
4. https://www.youtube.com/watch?v=8NcBcsIdPSA
5. https://www.youtube.com/watch?v=JJeAiKphFlY

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-136
Subject Name:SOFTWARE TESTING AND QUALITY ASSURANCE

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**15%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-3

Prerequisites: Software Engineering
Additional Material Allowed in ESE: Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Test the software by applying testing techniques to deliver a product free from bugs.
2.	Inspect the scenario and to select the proper testing technique.
3.	Compare and Contrast the various activities of Quality Assurance, Quality planning and Quality Control.
4.	Conduct formal inspections, record and evaluate results of inspections.
5.	Demonstrate various software evaluation techniques and interpret the relationship of SQA to software life cycle.

Detailed Contents:

UNIT-I **10 hours**

Software Testing Basics And Testing Techniques: Basic definitions, Testing as a process, Role of process in software quality Software testing principles, The tester's role in a software development organization, Origins of defects, Defect classes, The defect repository and test design, Defect examples, Developer / Tester support for developing a defect repository. Using White Box Approach to Test design - Static Testing Vs. Structural Testing, Code Functional Testing, Coverage and Control Flow Graphs, Using Black Box Approaches to Test Case Design, Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing.

UNIT-II **09 hours**

Levels Of Testing And Software Test Automation: Levels of Testing -Unit Testing, Integration Testing, Defect Bash Elimination. System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing. Software Test Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation, Tracking the Bug, Debugging.

UNIT-III **09 hours**

Quality Metrics And Software Quality Assurance: Testing Software System Security - Six-Sigma, TQM - Complexity Metrics and Models, Quality Management Metrics, Availability Metrics, Defect Removal Effectiveness, FMEA, Quality Function Deployment, Taguchi Quality Loss Function, Cost of Quality. SQA basics, Components of the Software Quality Assurance System, software quality in business context, planning for software quality assurance, product quality and process quality, software process models, QC Tools and Modern Tools.

UNIT-IV **08 hours**

Quality Assurance Models

Models for Quality Assurance, ISO-9000 series, CMM, CMMI, Test Maturity Models, SPICE, Malcolm Baldrige Model- P-CMM.

Text Books:

1. Srinivasan Desikan, Gopalaswamy Ramesh, Software Testing: Principles and Practices Pearson.
2. Daniel Galin, Software Quality Assurance: From Theory to Implementation, Pearson Addison Wesley.
3. Aditya P. Mathur, Foundations of Software Testing, Pearson.

Reference Books:

1. Paul Ammann, Jeff Offutt, Introduction to Software Testing, Cambridge University Press.
2. RenuRajani, Pradeep Oak, Software Testing – Effective Methods, Tools and Techniques, Tata McGraw Hill.

E-Books and Online Learning Material

1. Software Testing and Quality Assurance : Theory and Practice by KshirasagarNaik and PriyadarshiTripathi. Available at: https://www.softwaretestinggenius.com/download/staqtpsn.pdf, Accessed online on 15 Dec, 2019.
2. Software Testing by Yogesh Singh. Available at: https://www.softwaretestinggenius.com/download/staqtpsn.pdf, Accessed online on 23 Dec, 2019.

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106105150/ Accessed On 23 Dec, 2019.
2. https://freevideolectures.com/course/3655/software-testing Accessed On 23 Dec, 2019.

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-141
Subject Name:AGILE SOFTWARE DEVELOPMENT APPROACHES

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:10%**
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-4

Prerequisites: Software Engineering
Additional Material Allowed in ESE: Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Demonstrate the ability to participate effectively in agile practices/process for software development.
2.	Explain the purpose behind common agile practices. Ability to identify and address most common problems encountered in adopting Agile methods.
3.	Ability to identify and address most common problems encountered in adopting Agile methods.
4.	Apply agile principles and values to a given situation.
5.	Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems

Detailed Contents:

UNIT-I **06hours**

Introduction: Agile Software Development: Basics and Fundamentals of Agile Process Methods, The Agile Manifesto, Values of Agile, Principles of Agile, Project methodology selection, Challenges, Agile Methods- Extreme Programming (XP), Crystal, Lean, Scrum, Dynamic Systems Development Method and Feature-Driven Development.

UNIT-II **10 hours**

Scrum Principles: Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values. Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality.

UNIT-III **09 hours**

Agile Product Management and Agile Risk Management:Communication, Planning, Estimation Managing the Agile Approach Monitoring progress, Targeting and motivating the team, managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile Approach Monitoring progress, Targeting and motivating the team, managing business involvement and Escalating issue. Agile Requirements: User Stories, Backlog Management. Agile Architecture: Feature-Driven Development, Risk and Quality Assurance, Agile Tools.

UNIT-IV **07 hours**

Agile Testing and Agile Review:Agile Testing Techniques, Test-Driven Development, User Acceptance Test. Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, the rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools.

Scaling Agile for large Projects: Scrum of Scrums, Team collaborations, Scrum, estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.

Text Books:

1. M. C. Robert, "Agile Software Development, Principles, Patterns, and Practices", Pearson Education (2011)
2. M. Cohn, "Succeeding with Agile: Software Development Using Scrum", Addison-Wesley Professional (2010)

Reference Books:

1. J. Highsmith, "Agile Software Development Ecosystems", Addison-Wesley 2002
2. A. Cockburn, "Agile Software Development: The Cooperative Game" Addison Wesley (2006).
3. K. Schawber, M. Beedle, "Agile Software Development with Scrum" Pearson (2011).

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106105182/
2. https://www.coursera.org/specializations/agile-development
3. https://www.coursera.org/learn/software-processes-and-agile-practices

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MCS-142
Subject Name: HUMAN COMPUTER INTERACTION

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**15%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-4

Prerequisites: Fundamentals of Computer
Additional Material Allowed in ESE: Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Examine the capabilities of both humans and computers from the viewpoint of human information processing.
2.	Create the structure of human computer interaction models.
3.	Apply an interactive design process and universal design principles to design HCI systems.
4.	Depict and use HCI design principles, standards and guidelines.
5.	Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

Detailed Contents:

UNIT-I **08hours**

Foundations of Human Computer Interaction: Introduction to HCI, The Human: I/O channels, Memory, Reasoning and Problem Solving; The Computer: Devices, Memory, Processing and Networks; Interaction: Models, Frameworks, Ergonomics, Styles, Elements, Interactivity, Paradigms.

UNIT-II **08hours**

Design Process and Implementation: Interactive Design Basics: Process, Scenarios, Navigation, Screen Design, Iteration and Prototyping. HCI in Software Process: Software Life Cycle, Usability Engineering, Prototyping in Practice, Design Rationale. Design Rules: Principles, Standards, Guidelines, Rules. Evaluation Techniques: Universal Design.

UNIT-III **10hours**

User and Task Model: Cognitive Models, Socio-Organizational Issues and Stakeholder Requirements, Analyzing Tasks, Dialog Notations and Design.

Web Interface Design: Hypertext, Multimedia, World Wide Web, Overlays, Inlays and Virtual Pages, Contextual Tools, Designing Process, Case Studies.

UNIT-IV **10hours**

User Interface Evaluation: Heuristic Evaluation, Evaluation with Users, Model-based Evaluation, Mobile Application Frameworks, Types of Mobile Applications, Mobile Design Architecture and its Elements.

Computing Theories & Recent Trends: Groupware and Computer Supported Collaborative Work, Ubiquitous Computing, Virtual Reality and Augmented Reality, Speech Recognition and Translation.

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education.
2. Ben Shneiderman, Maxine Cohen, Catherine Plaisant, Steven M. Jacobs, "Designing the User Interface", 5th Edition, Pearson Education.
3. K. Meena, R. Sivakumar, "Human-Computer Interaction" PHI Learning, Delhi.
4. Shneiderman, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 5th Edition, Pearson Education India.

Reference Books:

1. Brian Fling, *"Mobile Design and Development",* 1st Edition , O"Reilly Media Inc.
2. Bill Scott and Theresa Neil, *"Designing Web Interfaces",* 1stEdition ,O"Reilly.
3. Dr. Samit Bhattacharya, *"Human-Computer Interaction: User-Centric Computing for Design",* 1st Edition, McGraw-Hill.

E-Books and online learning material

1. Human Computer Interaction
   https://www.researchgate.net/publication/224927543_Humancomputer_Interaction/link/02e7e51a84759ab04d000000/download Accessed on Dec.24, 2019
2. HCI - Fundamentals and Practicehttp://www.ittoday.info/Excerpts/HCI.pdf
   Accessed on Dec. 24, 2019
3. HCI – An Overview
   http://www.ee.cityu.edu.hk/~hcso/ee4213_ch1.pdf Accessed on Dec. 24, 2019

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106/103/106103115/ Accessed on Dec.24, 2019
2. https://nptel.ac.in/courses/106/106/106106177/ Accessed on Dec.24, 2019
3. https://swayam.gov.in/nd1_noc19_cs86/preview Accessed on Dec. 24, 2019

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-143
Subject Name: NATURAL LANGUAGE PROCESSING

Programme: M.Tech. (CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:** Nil
External Marks: 100	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 150	**Course Status:** Elective-4

Prerequisites: ---
Additional Material Allowed in ESE: Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Apply the computational knowledge for Natural Language Processing to understand the properties of natural languages, its algorithms for processing linguistic information in various tasks such as Machine translation, Information extraction and retrieval, and Speech Technology.
2.	Understand the concepts of linguistic foundations that underlie natural language processing, which would provide the knowledge for building components of NLP systems.
3.	Discover the capabilities, analyze them and explore the limitations of current natural language technologies, and some of the algorithms and techniques that underline these technologies to take up various research challenges in the field.
4.	Demonstrate the concepts of morphology, syntactic analysis, semantic interpretation and pragmatics of the language, and understanding them to apply in different research areas.
5.	Recognize the significance of research in natural language processing for common NLP tasks such as text classification, spam filtering, spell checking, machine learning, etc. to engage in lifelong learning.

Detailed Contents:

UNIT-I **8 hours**

Introduction: Need for processing of natural languages, Language processing levels, Issues and challenges in NLP, History, Classical approaches to NLP with knowledge bases and linguistic rules. Introduction to formal languages, finite state automata and regular expressions. Applications of NLP.

UNIT-II: **9 hours**

Morphology and Phonology: Morphology fundamentals, Inflectional and Derivational morphology, Morphological parsing, Finite State transducers, N- gram language models, phonetics

fundamentals, phoneme and phonological rules, machine learning of phonology, phonological aspects of prosody and speech synthesis.

UNIT-III: 9 hours

Part-of-Speech Tagging and Parsing: Word Classes, Part of speech tagging, Tagsets, Rule based, Stochastic and Transformation based POS tagging. Basic parsing strategies, top down parsing, bottom up parsing, parsing with context free grammars, a basic top down parser, Earley parser, CYK parser, Finite state parsing methods, Unification of feature structures.

UNIT-IV: 10 hours

Semantic Analysis and Pragmatics: Lexical Semantics, Lexemes, Relations among lexemes and their senses, WordNet, Internal structure of words, metaphor and metonymy & their computational approaches, Word Sense Disambiguation. Discourse, Reference resolution, syntactic and semantic constraints on coreference, pronoun resolution reference, text coherence, discourse structure, Dialogue- Acts, structure, conversational agents, Introduction to language generation, architecture, discourse planning.

Text Books:

1. D. Jurafsky and J. H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education.
2. J. Allen, "Natural Language Understanding", Addison Wesley.
3. T. Siddiqui and U.S. Tiwary, "Natural Languauge Processing and Information Retrieval", Oxford University Press.

Reference Books:

1. J. Handke, "The Structure of the Lexicon: Human Versus Machine (Natural Language Processing)", Mouton de Gruyter.
2. A. Bharati, V. Chaitanya and R. Sangal, "Natural Language Processing: A Paninian Perspective", Prentice Hall of India.

E-Books and online learning material

1. https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf
2. https://nlp.stanford.edu/fsnlp/

Online Courses and Video Lectures

1. Online course from IIT Kharagpurhttps://nptel.ac.in/courses/106/105/106105158/
2. Online course from IIT Bombay https://nptel.ac.in/courses/106/101/106101007/
3. Standford University, School of Engineering https://www.youtube.com/playlist?list=PL3FW7Lu3i5Jsnh1rnUwq_TcylNr7EkRe6

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-144
Subject Name: INFORMATION STORAGE AND MANAGEMENT

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-4

Prerequisites: Software engineering
Additional Material Allowed in ESE:NIL

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Explain the storage architectures, RAID and Intelligent storage systems.
2.	Illustrate the information security, and storage security domains.
3.	Identify different storage technologies and their benefits.
4.	Justify the parameters of managing and monitoring storage infrastructure; describe common storage management activities and solutions.
5.	Access the information security requirements and solutions.

Detailed Contents:

UNIT-I **12hours**

Introduction to Storage Technology: Creation of data and value of data for business, Information Lifecycle, Challenges in storage and managing the data, Solutions for data storage, Core elements of a Data Center infrastructure, role of each element in supporting business activities.

Storage Systems Architecture: Hardware and software components of the host environment, Key protocols and concepts used by each component, Physical and logical components of a connectivity environment. Concept of RAID and its components, Different RAID levels.Working of an intelligent storage system.

UNIT-II **08hours**

Introduction to Networked Storage: Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, Understand the need for long-term archiving solutions. Understand the appropriateness of the different networked storage options for different application environments.

UNIT-III **08hours**

Information Availability & Monitoring: Reasons for planned/unplanned outages and the impact of downtime, Impact of downtime. Differentiate between business continuity (BC) and disaster

recovery (DR), RTO and RPO, Identification of single points of failure in a storage infrastructure and solutions to mitigate these failures, Architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity.

UNIT-IV **08hours**

Securing Storage and Storage Virtualization: Information Security, Critical security attributes for information systems, Storage security domains, Analyze the common threats in each domain. Storage Virtualization: Forms, Configurations and Challenges. Types of Storage Virtualization: Block-level and File-Level.

Text Books:

1. G.Somasundaram, AlokShrivastava, EMC Education Series, "Information Storage and Management", Wiley, Publishing Inc.
2. Robert Spalding, "Storage Networks: The Complete Reference",TataMcGrawHill,Osborne

Reference Books:

1. Marc Farley, "Building Storage Networks",TataMcGraw Hill, Osborne.
2. MeetaGupta, Storage Area Network Fundamentals, Pearson Education Limited.
3. PSharma, "Information Storage & Management" by Kataria, S. K., & Sons.

E-Books and online learning material

1. Management Information Systems
https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/122105022/lec1.pdf
Accessed on Dec.23, 2019
2. Management Information Systems
https://www.sigc.edu/department/mba/studymet/ManagmentInformationSystem.pdf
Accessed on Dec.23, 2019

Online Courses and Video Lectures

1. https://www.digimat.in/nptel/courses/video/122105022/L01.html Accessed on Dec.23, 2019
2. http://www.digimat.in/nptel/courses/video/122105022/L16.html Accessed on Dec.23, 2019
3. https://www.digimat.in/nptel/courses/video/106105175/L01.html Accessed on Dec.23, 2019
4. https://nptel.ac.in/courses/122105022/15 Accessed on Dec.23, 2019
5. http://www.digimat.in/nptel/courses/video/122105022/L16.html Accessed on Dec.23, 2019

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-145
Subject Name: INTRODUCTION TO INTELLIGENT SYSTEMS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:10**%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-4

Prerequisites: Mathematics, Programming Languages
Additional Material Allowed in ESE:

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
2.	Compare intelligent system with human intelligence and traditional information processing and discuss its strengths and limitations as well as its application to complex and human-centred problems.
3.	Acquire the knowledge of real world Knowledge representation.
4.	Analyze the structures and algorithms of a selection of techniques related to searching, reasoning and learning.
5.	Use classical Artificial Intelligence techniques, such as search algorithms, minimax algorithm, neural networks.

Detailed Contents:

UNIT-I **10hours**

Biological foundations to intelligent Systems: Definition of Intelligent systems, Intelligent Agents: Agents & Environments, Concept of Rationality, Nature& Structure of Agents.
Artificial neural networks, Back propagation networks, Radial basis function networks and recurrent networks, Fuzzy Logic, Genetic algorithm and fuzzy neural networks.

UNIT-II **07hours**

Game Playing and Searching: Playing games: game tree, utility function, optimal strategies, minimax algorithm, alpha beta pruning, games with an element of chance.-environments.

UNIT-III **10hours**

Search Methods: Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search.
Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search.
Advanced search:Searching with nondeterministic actions, searching with partial observations, online search agents, Optimization and search such as stochastic annealing andgenetic algorithm.

UNIT-IV **09hours**

Knowledge representation and Reasoning: Knowledge Representation methods: Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components, ideas of Blackboard architectures.

Text Books:

1. Russel S. and Norwig P., "Artificial Intelligence: A Modern Approach", Prentice-hall.
2. Rich E., Artificial Intelligence, Tata McGraw Hills

Reference Books:

1. Luger G.F. and Stubblefield W.A., "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Addison Wesley.
2. Patterson D.W, Introduction to AI and Expert Systems, McGraw Hill.
3. CrinaGrosan, AjithAbraham,Intelligent Systems: A Modern Approach, Springer.

E-Books and online learning material

1. Artificial Intelligence: Foundations of Computational Agents by David L. Poole and Alan K. Makhworth
   https://www.freetechbooks.com/artificial-intelligence-foundations-of-computational-agents-t1039.html
2. Computers and Thought: A practical Introduction to Artificial Intelligence by Mike Sharples and David Hogg
   https://www.cs.bham.ac.uk/research/projects/poplog/computers-and-thought/
3. Arificial Intelligence by Patrick Winston
   http://www.aduni.org/courses/ai/index.php?view=cwAccessed on Dec.23, 2019

Online Courses and Video Lectures

1. https://freevideolectures.com/course/2272/artificial-intelligence
2. https://www.coursera.org/courses?query=artificial%20intelligence
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/
4. https://nptel.ac.in/courses/106/105/106105077/

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MCS-146
Subject Name: COMPUTER VISION

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:2	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:10**%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-4

Prerequisites: Digital Image Processing
Additional Material Allowed in ESE: -Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Identify basic terminology, theories and models in the field of Computer Vision.
2.	Analyze different methods of Computer Vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.
3.	Use and apply appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation.
4.	Assess which methods to use for solving a given problem, and analyze the accuracy of the methods.
5.	Design of Computer Vision system for a specific problem.

Detailed Contents:

UNIT-I **12hours**

Digital Image Formation and Low-Level Processing: Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth Estimation and Multi-Camera Views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

UNIT-II **08hours**

Feature Extraction and Image Segmentation: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

UNIT-III **08hours**

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

UNIT-IV **08hours**

Motion Analysis and Applications: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation. Recent trends in Activity Recognition, Computational photography, Biometrics.

Text Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2011th Edition, Springer, 2011.
2. Gonzaleze and Woods, "Digital Image Processing", 4th Edition, Pearson 2018.
3. Richard Hartley, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2011.
4. Dr Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

Reference Books:

1. KeinosukeFukunaga, *"Introduction to Statistical Pattern Recognition",* Academic Press Professional, Inc. San Diego, CA, USA.
2. Anil K. Jain, *"Fundamental of Digital Image Processing",* Prentice-Hall of India Pvt. Ltd

E-Books and online learning material

1. Computer Vision – Algorithms and Applications Accessed on Dec, 20, 2019
   http://szeliski.org/Book/
2. Computer Vision Metrics
   https://link.springer.com/book/10.1007%2F978-1-4302-5930-5 Accessed on Dec. 24, 2019
3. Computer Vision
   http://www.cse.iitm.ac.in/~vplab/courses/CV_DIP/PDF/INTRO_CV.pdfAccessed on Dec. 24, 2019
4. Foundations of Computer Vision
   https://faculty.ucmerced.edu/mcarreira-perpinan/teaching/ee589/lecture-notes.pdf
   Accessed on Dec. 24, 2019

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/106/105/106105216/ Accessed on Dec. 24, 2019
2. https://swayam.gov.in/nd1_noc19_cs58/preview Accessed on Dec. 24, 2019

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MCS-151
Subject Name: OPTIMIZATION TECHNIQUES

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:80**%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-5

Prerequisites: Linear Algebra and Numerical Methods
Additional Material Allowed in ESE: -Scientific calculator

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	To develop optimization thinking and problem solving methods for solving different types of problems**.**
2.	To examine the optimization principle and its application in formulation of engineering optimization problems.
3.	To optimize the mathematical problems using nature based algorithms.
4.	To solve various constrained and unconstrained problems in Single variable as well as multivariable.
5.	To understand the advanced optimization methods and apply it on real world problems.

Detailed Contents:

UNIT-I **08 hours**

Introduction: Optimization principles, Classification of Optimization Algorithms: Single-variable and multi-variable functions, Classical and numerical optimization techniques, Formulation of Engineering Optimization Problems.

UNIT-II **12 hours**

Constrained Optimization Techniques and Specialized Techniques: Kuhn-Tucker conditions, Duality Theory, Penalty function method, Multiplier method, Variable elimination method, Direct and Linearized Search Techniques. Integer and Geometric programming, Linear Programming, Quadratic Programming..

UNIT-III **11hours**

Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Integer Programming, Semi Definite Programming.

UNIT-IV **09 hours**

Advanced Optimization Methods: Genetic algorithms, Particle swarm optimization, Ant colony optimization, Bee colony optimization, Simulated Annealing

Case Study: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.

Text Books:

1. Laurence A. Wolsey, "Integer Programming", Wiley.
2. Andreas Antoniou, "Practical optimization Algorithms and Engineering Applications".

Reference Books:

1. Edwin K., P. Chong, Stanislaw H. Zak, "An Introduction to Optmization".
2. Dimitris Bertimas, RobertWeismantel, "Optimization over integers. Dynamic Ideas".
3. John K. Karlof, "Integer programming Theory and Practice", CRC Press.
4. H. Paul Williams, "Logic and Integer Programming", Springer.
5. Michael Junger, Thomas M. Liebling, Denis Naddef, George Nemhauser, William R. Pulleyblank, Gerhard Reinelt, Giovanni Rinaldi, Laurence A. Wolsey, eds, "50 years of Integer Programming", Springer.
6. Der-San Chen, Robert G. Batson, Yu Dang, "Applied Integer Programming: Modelling and Solution" , John Wiley and Sons.

E-Books and online learning material

1. Engineering Optimization by Singiresu S. Rao
   http://mec.nit.ac.ir/file_part/master_doc/20149281833165301436305785.pdf
   Accessed on 25/12/2019.
2. Optimization Techniques and Applications with Examples by Xin-She Yang.
   https://www.academia.edu/37696657/Optimization_Techniques_and_Applications_with_Examples
   Accessed on 25/12/2019.
3. An Introduction to Optimization: Foundations and Fundamental Algorithms by NiclasAndr´easson, Anton Evgrafov, and Michael Patrikssonhttp://www.math.chalmers.se/Math/Grundutb/CTH/tma947/0405/kompendium_sub.pdf
   Accessed on 25/12/2019.

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/111105039/Accessed on 25/12/2019.
2. https://www.mooc-list.com/tags/optimization-methodsAccessed on 25/12/2019.

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MCS-152
Subject Name: SOCIAL NETWORK ANALYSIS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**10%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-5

Prerequisites:Computer Networks
Additional Material Allowed in ESE: - Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	To obtain the Historical background, basic concepts, applications of Social networks analysis
2.	Analyze the behavior of social media clusters, graphs, data, and various community measures
3.	Modal and conduct basic social network analysis to include centrality, subgroup analysis, social theory, and statistical analysis of networks
4.	Apply the knowledge on over-time network analysis including statistical change detection, exponential random graph modelling, and stochastic actor oriented modeling
5.	Mine the behaviour of user in the social network

Detailed Contents:

UNIT-I **10 hours**

Overview of Social Media: Social Network Analysis: Brief History, Definitions, Features, Basic Concepts of Social Network Analysis, Concepts, and Research

Graphs and Centrality: Terminology, basic graph theory, and network centrality measures..

UNIT-II **06hours**

Social Theory and Network Topology: Sociological theories behind the formation of relationships and group structure. Introduction to Six social forces (prestige, reciprocity, homophily, propinquity, transitivity, and structural balance)

UNIT-III **09hours**

Network and Community Measures: Centralization, fragmentation, clustering coefficient, density, and other graph-level and community measures

Clustering and Subgroup Analysis: A review of common clustering algorithms for use in networks and their application. Block modeling, modularity, graph reduction, localized network measure.

UNIT-IV **09hours**

Data and APIs: Data considerations to include changing APIs, differing data storage challenges for weighted/unweighted, sparse/dense networks. Collection bias for network chaining, random sampling, missing data, and other collection issues.

Statistical Analysis of Networks: Introduction to exponential random graph models. Hypothesis testing and time series analysis.

Text Books:

1. BorkoFurht, "Handbook of SocialNetworkTechnologiesand Applications" springer
2. Marshall Sponder, "Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics 2013
3. Gonçalves, Alex, "Social Media Analytics Strategy Using Data to Optimize Business Performance" 2017

Reference Books:

1. Giles Mark, Smith, John Yen, "Advances in Social Network Mining and Analysis" Springer
2. Charu C. Aggrwal, "Social Network Data Anaytics" Springer

E-Books and online learning material

1. https://www.archiv.politaktiv.org/documents/10157/29141/SocNet_TheoryApp.pdf

Online Courses and Video Lectures

1. https://www.coursera.org/learn/social-network-analysis#syllabus Access date: 27 January 2020

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Course Code: MCS-153
Subject Name: DISTRIBUTED SYSTEMS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**20%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-5

Prerequisites: Data-ware House and Data Mining

Additional Material Allowed in ESE: - Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Classify distributed systems in various system models with its characteristics, working and applications
2.	Examine communication methodologies with characteristics of Operating System and Virtualization concept
3.	Illustrate the concept of distributed file system, directory services and name services with case studies
4.	Explain distributed transaction and concurrency control mechanisms with deadlocks and recovery concepts
5.	Investigate and plan designing of distributed systems with the consideration of case studies and distributed services

Detailed contents:

Unit-I **10 Hours**

Characterization of Distributed Systems: Introduction, Focus on resource sharing, examples and trends in distributed systems, system models –Architectural and fundamental models, Inter-process communication: API for internet protocol, Marshalling. Client server communication, group communication

Distributed objects and remote invocation: request-reply protocol, remote procedure call, events and notification, case study: Java RMI, Operating System Support: Operating System layer, Protection, processes and threads, operating system architecture, Virtualization at the Operating System level

Unit-II **7 Hours**

Distributed File System: File service architecture, network file system, Sun network file system, Andrew file system, further developments, and Name services and domain name system. Directory and discovery services, Case Study: Global Name service

Unit-III **11 Hours**

Transaction and concurrency control: transactions, nested transactions, Locks, optimistic concurrency control, time stamp ordering, Distributed transaction: Flat and nested distributed transactions. Atomic Commit protocol, Distributed dead locks, transaction recovery

Distributed Multimedia systems; characteristics of multimedia data. Quality of service management, resource management, stream adaptation, Case study; Tiger video file server.

Unit 6: **8 Hours**

Designing distributed Systems: Introducing the case study: Google, architecture and design philosophy, underlying communication paradigms, data storage and coordination services, distributed computation services.

Text Books:

1. G. Coulouris, et al. *Distributed Systems*: Concepts and design, Pearson Education Asia
2. Attiya, Welch, "*Distributed Computing*", Wiley India

Reference Books:

1. A.S. Tanenbaum, *Modern operating Systems*, Prentience Hall
2. Kai Hwang and Zhi.WeiXu, "*Scalable Parallel Computing*", Tata McGraw-Hill, New Delhi
3. Singhal and Shivaratri, "*Advanced Concepts in Operating Systems*", McGrawHill

E-Books and Online Learning Material:

1. Distributed Systems by G.Coulouris
   https://ce.guilan.ac.ir/images/other/soft/distribdystems.pdf Accessed on Dec.26, 2019
2. Distributed Systems by A.S. Tanenbaum
3. http://barbie.uta.edu/~jli/Resources/MapReduce&Hadoop/Distributed%20Systems%20Principles%20and%20Paradigms.pdf Accessed on Dec.26, 2019

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/106106168/ Accessed on Dec.26, 2019
2. https://www.digimat.in/nptel/courses/video/106104182/L01.html Accessed on Dec.26, 2019

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MCS-154
Subject Name: NEURAL NETWORKS AND FUZZY LOGIC

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 34 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:3**0%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 150	**Course Status:** Elective-5

Prerequisites: AI, Machine learning
Additional Material Allowed in ESE:NIL

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Comprehend the fuzzy logic control and adaptive fuzzy logic.
2.	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
3.	Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
4.	Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem.
5.	Integrate neural network and fuzzy logic to extend the capabilities for efficient and effective problem solving methodologies

Detailed Contents:

UNIT-I **8 hours**

Neural Networks Characteristics: History of Development in neural networks, artificial neural net terminology, model of a neuron, Topology, Types of learning. Supervised, Unsupervised learning. Basic Learning laws, Hebb's rule, Delta rule, widrow and Hoff LMS learning rule, correlation learning rule instar and ouster learning rules

UNIT-II **9 hours**

Multi-layer networks and Associative Memory: Back propagation (BP) network, BP training algorithm, Radial basis function (RBF) networks, Applications of BP and RBF networks. Recurrent networks and unsupervised learning, Hopfield network - energy; stability; capacity; Application to optimization problems, Counter back propagation network, Boltzmann machine, Kohonen's self-organizing feature maps, Adaptive resonance theory., Learning Vector Quantization (LVQ),Associative memory: Matrix associative memory, Auto associative memories, hetero

associative memories, Bi-directional associative memory, applications of associative memories.

UNIT-III **9 hours**

Fuzzy relations and fuzzy logic: Basic concepts of crisp sets and fuzzy sets, Types of fuzzy sets, Operation on fuzzy sets, Crisp vs fuzzy relations, binary relations, equivalence relations, tolerance relations, composition of relations, fuzzy relational equations, fuzzy measure and possibility theory, classical logic and multivalued logic, fuzzy propositions and approximate reasoning.

UNIT-IV **8 hours**

Adaptive Fuzzy Systems: Performance index, Modification of rule base0, Modification of membership functions- Simultaneous modification of rule base and membership functions, Relevance of Integration between fuzzy sets and neural network, Fuzzy neural network, Neuro fuzzy systems, Fuzzy associative memories.

Text Books:

1. R. Rajasekaran and G. A and Vijayalakshmi Pa, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications", Prentice Hall of India
2. S. Haykin, "Neural Networks. A comprehensive Foundation", Prentice Hall.
3. BerkinRiza C and Trubatch, "Fuzzy System design principles- Building Fuzzy IF-THEN rule
bases", IEEE Press.
4. Yegna Narayanan, "Artificial Neural Networks". Prentice Hall of India.\

Reference Books:

1. T. Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill
2. Xin-She Yang , "Nature-Inspired Metaheuristic Algorithms", Luniver Press.
3. Simon Haykin, "Neural Networks" Pearson Education.
4. Yen and Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education.

Video Lectures and Online Learning Material:

1. https://nptel.ac.in/courses/127105006/ Accessed on 16 Jan,2020
2. https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html Accessed on 16 Jan,2020

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
Syllabus
M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MCS-155
Subject Name: DATA PREPARATION AND ANALYSIS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**20%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-5

Prerequisites: None
Additional Material Allowed in ESE: -Scientific calculator

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Solve the real world problems using the concept of data analysis and hypothesis testing procedures to retrieve data and solve problems.
2.	Apply knowledge of measurement & scaling techniques as well as the quantitative data analysis to process raw data.
3.	Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
4.	Evaluate and select appropriate data-mining algorithms and apply, interpret and report the output appropriately.
5.	Identify suitable data preprocessing technique to apply on raw data to provide suitable input to various algorithms used for different purposes.

Detailed Contents:

UNIT-I **10 hours**

Introduction to Data Analysis : Problem definition , Data preparation, Implementation of the analysis , Deployment of the results, Data sources , Data understanding, Data preparation, Tables and graphs.

Exploratory Analysis: Descriptive statistics-Central tendency , Variation, Shape.Inferential statistics- Confidence intervals , Hypothesis tests, Chi-square, One way analysis of variance. Comparative statisticsVisualizing relationships Correlation coefficient(r), Correlation analysis for more than two variables.

UNIT-II **06hours**

Grouping: Introduction,Clustering: Hierarchical agglomerative clustering, K means clustering. Associative rules: Grouping by value combinations, Extracting Rules from groups. Decision trees :Tree generation , Splitting criteria.

UNIT-III **09hours**

Prediction: Introduction, Simple Regression models,K-nearestneighbors,Classification and regression trees, Neural networks: Introduction Neural network layers, Node calculations, Neural network predictions Learning process, Backpropagation.

UNIT-IV **09hours**

Data Preprocessing: Introduction, Data Cleaning, Data Integration ,Data Reduction , Data Transformation and Data Discretization.

Data Visualization: Pixel-Oriented Visualization Techniques , Geometric Projection Visualization Techniques , Icon-Based Visualization Techniques , Hierarchical Visualization Techniques , Visualizing Complex Data and Relations

Reference Books:

1. G. Coulouris, et al. Distributed Systems: Concepts and design, Pearson Education Asia
2. A.S. Tanenbaum, Modern operating Systems, Prentience Hall
3. Attiya, Welch, "Distributed Computing", Wiley India
4. Kai Hwang and Zhi.WeiXu, "Scalable Parallel Computing", Tata McGraw-Hill, New Delhi
5. Singhal and Shivaratri, "Advanced Concepts in Operating Systems", McGrawHill

E-Books and Online Learning Material:

1. David Kriesel, "A Brief Introduction to Neural Networks", http://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf
2. Howard J. Seltman , "Experimental Design and Analysis", http://www.stat.cmu.edu/~hseltman/309/Book/Book.pdf

Online Courses and Video Lectures

1. https://www.educator.com/mathematics/statistics/son/central-tendency_-mean-median-mode.php
2. https://www.khanacademy.org/math/engageny-alg-1/alg1-2/alg1-2a-center/v/statistics-intro-mean-median-and-mode?modal=1
3. https://www.coursera.org/lecture/six-sigma-analyze-advanced/anova-chi-square-5PnIo
4. https://www.coursera.org/lecture/machine-learning/k-means-algorithm-93VPG
5. https://missinglink.ai/guides/neural-network-concepts/backpropagation-neural-networks-process-examples-code-minus-math/

Guru Nanak Dev Engineering College, Ludhiana
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M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MCS-156
Subject Name: SMART SENSORS AND INTERNET OF THINGS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**20%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-5

Prerequisites: Wireless Networks
Additional Material Allowed in ESE: -Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Understand the working of smart sensors in IOT context.
2.	Apply knowledge in usage of smart devices, Gateways and Data Management in IoT.
3.	Understand the vision of IoT from a local as well as global context.
4.	Apply IoT to resolve many Industrial cum Commercial Building Automation and Real World Design Constraints.
5.	Determine the Market trends of IoT in smart sensing.

Detailed Contents:

UNIT-I **10 hours**

Environmental features of Measurement and Monitoring: Importance, effects of adverse parameters for the living being for IOT.

Sensors: Principles and Working with their Types; Selection and usage of Sensors for Practical Applications, Overview of various kinds of Sensors like Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.

UNIT-II **06hours**

Important Properties of Sensors: Determination of the Fractional order elements, Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality.

UNIT-III **09hours**

Architecture of Smart Sensors: Importance and components, Features, Fabrication of Sensor and Smart Sensor (Electrode fabrication, Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel).

UNIT-IV **09hours**

Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor. Recent trends in smart sensor in daily life, Evolving sensors and their architecture cum usage.

Reference Books:

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing.
2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

E-Books and Online Learning Material:

1. "Networking Wireless Sensors" Bhaskar Krishnamachari. https://epdf.pub/networking-wireless- sensors707cd173e9667a9eb2f5b1b0f7864 b6873115.html Accessed on Jan.27, 2020

2. Smart sensors and systems by Youn-Long Lin, Chong-Min Kyung, Hiroto Yasuura, Yongpan Liu https://www.kobo.com/us/en/ebook/smart-sensors-and-systems and https://link.springer.com/book/10.1007/978-3-319-14711-6Accessed on Jan 20, 2020.

3. Wireless Sensor Networks by NirupamaBilusu https://epdf.pub/wireless-sensor-networks-artech-house-mems-and-sensors-library.html Accessed on Jan 24, 2020.

Online Courses and Video Lectures

1. https://swayam.gov.in/nd1_noc20_cs22/preview Accessed on Jan.27, 2020
2. https://swayam.gov.in/nd1_noc20_cs24/preview Accessed on Jan.27, 2020
3. https://nptel.ac.in/courses/106/105/106105166 Accessed on Jan.24, 2020
4. https://nptel.ac.in/courses/106/105/106105195 Accessed on Jan.24, 2020

Guru Nanak Dev Engineering College, Ludhiana
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M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: MOCS-101
Subject Name: SIMULATION AND MODELLING

Programme:M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**70%
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Open Elective

Prerequisites: Basic knowledge of numerical mathematics, probability and statistics

Additional Material Allowed in ESE: Scientific Calculator

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Construct a model for a given set of data and analyse output produced to test validity of the model
2.	Apply numerical methods to interpret, extract, analyse and present simulation result.
3.	Develop simulation programs to design a system that meets industrial requirements and solves real world problems based on client server communication
4.	Test modern simulation tools and resources to measure the performance of different simulation models
5.	Make use of problem solving approaches to work challenges and make decisions in teams

Detailed Contents:

UNIT-I **10 hours**

Introduction: Understanding the concept of Modeling and simulation,, system simulation, Need of simulation studies, Applications, Parameters of performance, evaluation of system, Simulation model verses Analytical model, Classification of Models, Role of simulation in model evaluation, discrete event simulation, Monte Carlo simulation, Steps in simulation studies, Simulation examples.

UNIT-II **08 hours**

Probability concepts in Simulation:A review **o**f basic probability and statistics, random variables and their properties, Estimation of means variance and correlation, stochastic variables, discrete and continuous probability functions, Random numbers, Generation of Random numbers

UNIT-III **08 hours**

Queuing Models: Characteristics of queuing system, Queuing notation, Long-Run measures of performance of queuing systems, steady state behavior of infinite and finite calling population models, Use of network of queues.

UNIT-IV **10 hours**

Input Modeling and Output Analysis of a Single Model:Datacollection,identifying the distribution of data – Histogram and quantile plots, Parameters estimation, Goodness of fit tests applied to simulation inputs, Verification and validation of simulation models, Output analysis and measures of performance and estimation**.**

Text Books:

1. J. Banks, J.S. Carson II, B. L. Nelson and D. M. Nicol, "Discrete- event system and simulation", Prentice Hall of India, 2010.
2. M. Law, "Simulation Modeling and Analysis", Tata McGraw Hill India, 2007.

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Reference Books:

1. G.A. Wainer, "Discrete-event modeling and simulation: a practitioner's approach", CRC Press, 2009.
2. B.P. Zeiger, H. Praehofer and T. G. Kim, "Theory of modeling and simulation: integrating discrete event and continuous complex dynamic systems", Academic Press, 2000.
3. W. J. Karplus, G. A. Bekey and B. YakobKogan, "Modeling and simulation: theory and practice", Springer, 2003. Department of Computer

E-Books and online learning material

1. https://ptolemy.berkeley.edu/books/Systems/PtolemyII_DigitalV1_02.pdf
2. https://www.tutorialspoint.com/modelling_and_simulation/modelling_and_simulation_tutorial.pdf
3. https://gurukpo.com/Content/BCA/Simulation_Think_tank.pdf

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/112107220/
2. https://nptel.ac.in/courses/112107214/
3. https://www.coursera.org/lecture/modeling-simulation-natural-processes/modeling-and-simulation-F7vas
4. https://freevideolectures.com/course/3675/vlsi-devices-modeling-and-simulation

Guru Nanak Dev Engineering College, Ludhiana
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M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MOCS-102
Subject Name: PROJECT MANAGEMENT

Programme:M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:10%**
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Open Elective

Prerequisites: System Analysis and Design
Additional Material Allowed in ESE:- Scientific Calculator

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Relate the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
2.	Outline the project to the organization's strategic plans and business justification throughout its life-cycle.
3.	Illustrate project goals, constraints, deliverables and performance criteria in consultation with stakeholders.
4.	Examine the tools and techniques in order to achieve project success.
5.	Justify general business concepts, practices, and tools to facilitate project success.

Detailed Contents:

UNIT-I **10 hours**

Concept of Project and Project Management: Definition, Characteristics, Project Management-Meaning and Scope, Types, Project Identification and Screening, Role of Project manager, Project life-cycle.

Project Appraisal: Technical appraisal, Environmental appraisal, Economic and market appraisal, Organizational or Managerial appraisal, Financial Appraisal: Project cost estimation and working capital requirements, Sources of funds, Capital Budgeting and Budgeting controls for projects.

UNIT-II **06hours**

Cost Benefit Analysis: Cost-Benefit Evaluation Techniques: Payback method, Accounting rate of return, Internal rate of return, Net present value method, Net terminal value method, Multiple internal rate of return, Earned Value analysis. Projected balance sheet, Projected income statement, Projected funds and cash flow statements, Preparation of detailed project report.

UNIT-III **09hours**

Project Risk Management: Risk Management, Categories of risk - Market risk, Technical risk. RiskIdentification,RiskAssessment,RiskPlanning,Evaluating risks to the schedule,PERT Technique.

Social Cost Benefit Analysis (SCBA): Meaning, Rationale, Approaches to SCBA - UNIDO approach, L-M approach, Social appraisal of projects in developing countries with special reference to India.

UNIT-IV **09hours**

Implementation of Projects: Project scheduling and control, Problems of project implementation, Project audit, Project Management Information Systems, Place of Software Quality in Project Planning,Importance of Software Quality,Case studies on Process capability Models.

Text Books:

1. P. Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw Hill Education Private Limited.
2. Bob Hughes, "Software Project Management", McGraw Hill Education.

Reference Books:

1. Y. Y. Chong and E. M. Brown, "Managing Project Risk", Pearson Education.
2. Ghattas and McKee, "Practical Project Management", Pearson.
3. H. Maylor, "Project Management", Pearson.

E-Books and online learning material

1. https://bookboon.com/en/project-management-ebooks
2. https://project-management.com/top-10-best-project-management-books-to-keep-within-reach/
3. https://www.simplilearn.com/resources/project-management/ebooks

Online Courses and Video Lectures

1. https://blog.capterra.com/the-5-best-online-project-management-courses/
2. https://www.youtube.com/watch?v=wJ8HZ7hqUs8
3. https://www.youtube.com/watch?v=Wk607ruc8P0
4. https://www.youtube.com/watch?v=5d16JwWwjKo

Guru Nanak Dev Engineering College, Ludhiana
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2019 Admission Batch Onwards

Subject Code: - MOCS-103
Subject Name: BUSINESS INFORMATION SYSTEM

Programme:M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:10%**
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Open Elective

Prerequisites: None
Additional Material Allowed in ESE: - NIL

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	To enrich the knowledge of Information System, its application and role in Modern Business and to analyze the impact of technology on development track.
2.	To elicit, analyze and architect the Data and to adapt Data Resource management approach.
3.	To analyze Integration of business and technology skills in a sector context**.**
4.	To use different business development methodologies and design a business strategy.
5.	To identify the various threats and security issues in Business Information System.

Detailed Contents:

UNIT-I **12 hours**

Understanding Information System in Business: Introduction to systems and Information System, Impact of IS in Business, Transformation from Old to Digital Economy, Components of IS, Resources that support BIS, Categories of BIS, E-business system. Computer in Business Development of Data Systems- Overview of Hardware and Software, Networks, Telecommunication and Internet, Scenario in India, Networking Technologies- Wi-Fi, WiMax, NextGen mobile networks, Data Capture and Computer Input / Output.

UNIT-II **06hours**

Data Resource Management: Differentiating Data and Information, Traditional Processing Systems, Database approach and its advantages, Components of database environment, Concepts of Data Warehousing, Data Mining and Tools, OLAP, Data Visualization, Data Centers, Fabric Data Centers, Server Farms, Big Data, Business Analytics.

UNIT-III **10hours**

Enterprise and Functional Business Systems: Classification of IS – TPS, MIS, DSS, AI, Expert Systems**,** NLP, Inventory Management (INMANS) System, Account Payable System (ACPAYS), Payroll System (PAYSY). **Developing & Implementing Business Systems-** Feasibility studies, Risk Management, SDLC, Phases, Implementation of Business Systems, Management of IS – Organizing data & information processing, roles & responsibilities of IS professionals.

UNIT-IV **09hours**

Information System Security and Control: Threat of Project Failure, Threat of Accidents and Malfunctions, Threat of Computer Crime, Protecting Information System against Security Breaches, Factors that Increase the Risks, Methods for Minimizing Risks.

Text Books:

1. Paul Bocij, Andrew Greasley, Simon Hickie, "Business Information Systems: Technology, Development & Management".
2. PalgeBaltzan, "Business Driven Information System", McGraw Hill Publication.

References:

1. R. Kelly Rainer, Brad Prince, Watson, "Management Information System", Wiley Publication.
2. Nandan Kamath, "Guide to information technology act, rules and regulations", Universal Law Pub.

E-books and online learning material:

1. Business Information System by Elizabeth Hardcastle
http://www.promeng.eu/downloads/training-materials/ebooks/business-information-systems.pdf
Accessed on 25/12/2019.

Online Courses and Video Lectures:

1. https://www.coursera.org/specializations/information-systemsAccessed on 25/12/2019.
2. https://nptel.ac.in/courses/110/105/110105083/Accessed on 25/12/2019.

Guru Nanak Dev Engineering College, Ludhiana
Department of Computer Science and Engineering
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M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: - MOCS-104
Subject Name: HUMAN RESOURCES DEVELOPMENT AND TRAINING METHODS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:10%**
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Open Elective

Prerequisites: None
Additional Material Allowed in ESE: -Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	To develop and understanding the concept of human resource development and to understand its relevance in organizations
2.	To analyse the strategic issues and strategies required to select and develop manpower resources.
3.	To integrate the knowledge of HR concepts to take correct business decisions.
4.	To develop necessary skill set for application of various HR issues.
5.	To understand the Globalization Impact on HRD and how to reduce work force.

Detailed Contents:

UNIT-I **07 hours**

Human Resource Development – Evolution of HRD - Relationship with HRM - Human Resource Development Functions - Roles and Competencies of HRD Professionals - Challenges to Organization and HRD professionals – Employee Behaviour – External and Internal Influence – Motivation as Internal Influence – Learning and HRD – Learning Strategies and Styles

UNIT-II **09hours**

Frame work of Human Resource Development - HRD Processes - Assessing HRD Needs - HRD Model - Designing Effective HRD Program - HRD Interventions- Creating HRD Programs - Implementing HRD programs - Training Methods - Self Paced/Computer Based/ Company Sponsored Training – On-the-Job and Off-the-Job - Brain Storming - Case Studies - Role Plays - Simulations - T-Groups – Transactional Analysis**.**

UNIT-III **12 hours**

Evaluating HRD programs - Models and Frame Work of Evaluation - Assessing the Impact of HRD Programs - Human Resource Development Applications - Fundamental Concepts of Socialization -Realistic Job Review - Career Management and Development.

Management Development - Employee counseling and wellness services – Counseling as an HRD Activity - Counseling Programs - Issues in Employee Counseling - Employee Wellness and Health Promotion Programs - Organizational Strategies Based on Human Resources.

UNIT-IV **08hours**

Work Force Reduction, Realignment and Retention - HR Performance and Bench Marking – Impact of Globalization on HRD- Diversity of Work Force - HRD programs for diverse employees - Expatriate & Repatriate support and development.

Text Books:

1. Werner &Desimone, Human Resource Development, Cengage Learning, 2006
2. William E. Blank, Handbook For Developing Competency Based Training Programmes, Prentice-Hall, New Jersey, 1982.
3. Uday Kumar Haldar, Human Resource Development, Oxford University Press, 2009 .

Reference Books:

1. S. Kandula" Strategic Human Resource Developmnet", by PHI Learning, 2001
2. J. M. Werner and R. DeSimone "Human Resource Development"
3. Prasad ,"Strategic Human Resource Development: Concepts and Practices" E-Books and online learning material

E-books and online learning material:

1. Human Resources Development by Jon M Werner https://www.yyu.edu.tr/images/files/Turizmde_Insan_Kaynaklari_Gelisimi_Doc_Dr__Zekeriya_NAS(1).pdf
2. Human Resources Development by Lalithabalakrishnan and S Srividhya https://www.worldcat.org/title/human-resource-development/oclc/681732370

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/109105121/
2. https://nptel.ac.in/courses/110/105/110105069/
3. https://www.youtube.com/results?search_query=human+resource+development
4. https://www.youtube.com/results?search_query=human+resource+development+issues

Guru Nanak Dev Engineering College, Ludhiana
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Subject Code: - MOCS-105
Subject Name: MULTIMEDIA COMMUNICATIONS

Programme: M.Tech.(CSE)	**L:** 3 **T:** 0 **P:** 0
Semester:3	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:10%**
External Marks: 100	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 150	**Course Status:** Elective-5

Prerequisites: None
Additional Material Allowed in ESE: -Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Analyze and use various multimedia communication models.
2.	Apply QoS to multimedia network applications.
3.	Identify the various audio video formats and compression techniques for better transformation of media over the network.
4.	Implement the concepts of multimedia to develop the real-time multimedia network applications.
5.	Explain the technical characteristics and performance of multimedia system and terminal.

Detailed Contents:

UNIT-I **10 hours**

Introduction: Motivation, evolution of multimedia, structure and components of multimedia, multimedia information representation, multimedia networks, Application and networking terminology, QoS, Digitization principles, Text, images, audio and video.

UNIT-II **08 hours**

Text and image compression, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3coding, image compression of different formats.

UNIT-III **09hours**

Psychoacoustics: frequency and amplitude sensitivity of hearing, music and noise , video principles and broadcast standards , Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression.

Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework, IDTV and HDTV principles.

UNIT-IV **09hours**

Multimedia Document Interchange Formats: Hypertext, HTML, MHEG, SGML, Open Document Architecture, Open Media Framework. Authoring Tools and Metaphors: Authoring tools: Productivity and Creativity, survey of authoring tools: book metaphor, slideshow metaphor, time-line metaphor, network and icon metaphor

Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques.

Text Books:

1. Fred Halsall, "Multimedia Communications", Pearson education,2001.
2. Raif Steinmetz, KlaraNahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education,2002.

Reference Books:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education.
2. John Billamil, Louis Molina, "Multimedia : An Introduction", PHI.
3. Prabhat K. Andleigh, Kiran Thakrar, "Multimedia Systems Design", PHI.

E-books and online learning material:

1. https://www.kopykitab.com/Multimedia-Communications-by-Krishna-Kumar
2. https://www.researchgate.net/publication/315560840_Multimedia_Communications.
3. https://www.scribd.com/document/349179653/Multimedia-Communications-by-Fred-Halshall

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/117/105/117105083/
2. https://academicearth.org/communications/
3. https://study.com/articles/Colleges_with_Online_Courses_in_Multimedia_Communications_How_to_Choose.html

Guru Nanak Dev Engineering College, Ludhiana
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M.Tech. (Computer Science and Engineering)
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Subject Code: LMCS - 131
Subject Name: CRYPTOGRAPHY LAB

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:**1
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:**90%
External Marks:50	**Duration of End Semester Exam(ESE):**2 hours
Total Marks: 100	**Course Status:** Elective-3

Prerequisites: Computer Networks

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Implement encryption and decryption techniques for providing security solutions.
2.	Analyze the impact of public key cryptosystems for secure exchange of information.
3.	Analyze and design Network Security protocols for information exchange over unsecure network.
4.	Apply security principles for implementing authentication applications.
5.	Justify the use of hashing and authentication for implementing data integrity.

Special Instruction related to resources requirement: Any programming language like C, C++, can be used for the programs.

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	Implement the following Symmetric key cipher techniques : a) Caesar Cipher b) Playfair Cipher c) Hill Cipher d) Simple Columner Transposition technique e) Rail fence – Row & Column Transformation etc.	6
2.	Implement Diffie-Hellman Key exchange algorithm.	2
3.	Implement RSA Public Key algorithm.	2
4.	Implement Stream cipher algorithm – RC4.	2
5.	Implement Block cipher algorithms – DES/AES.	4
6.	Calculate the message digest of text using message digest algorithm.	4
7.	Case Study of Digital Signature and Kerberos.	4

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M.Tech. (Computer Science and Engineering)
2019 Admission Batch Onwards

Subject Code: LMCS-132

Subject Name: WIRELESS SENSOR NETWORKS LABORATORY

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**70%
External Marks: 20	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 50	**Course Status:** Elective-3

Prerequisites: Computer Networks

Additional Material Allowed in ESE: Nil

On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Know the basics of Ad hoc networks and Wireless Sensor Networks
2.	Apply the knowledge to configure various network topologies.
2.	Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement
3.	Apply the knowledge to identify appropriate performance parameter of MAC and Routing protocols.
4.	Understand the key features of Ad hoc and sensor networks.
5.	Be familiar with the features, merits and demerits of Wireless Sensor Network Tools.

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	Introduction to various simulation tools of Wireless sensor network	2
2.	Installation and configuration of any simulation tool MATLAB/NS2/ OPNET++ /etc.	4
3.	Implementation of network topology for static WSN	2
4.	Analyze the performance parameters of different performance parameters	2
5.	Implementation of routing protocol for AODV protocol.	2
6.	Implementation of routing protocol for DSR protocol.	2
7.	Implement and demonstrate the working of LEACH routing protocol	2
8.	Implement and demonstrate the concept of data dissemination and data gathering.(e.g. PEGASIS/ SPIN/etc.)	2
9.	Study and Implement WSN for mobile nodes with different parameters	2
10.	Comparative study of various simulation tools with their merits and demerits.	4

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Subject Code: LMCS-133
Subject Name: NETWORK SECURITY LAB

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**60%
External Marks: 20	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 50	**Course Status:** Elective-3

Prerequisites: Computer networks
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Demonstrate the working of Open SSL in various domains.
2.	Predict the concept of Authentication and Encryption to secure the network transmission.
3.	Implement the wireless audit and decryption strategy for Routing a packet over the network.
4.	Analyze the functionality of various e-commerce services along with various issues associated with it.
5.	Design a Honey Pot over the network for secured transmission of packets.

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	Steps to ensure security of any one web browser (Mozilla Firefox/Google chrome)	**2**
2.	Learn to install virtual box or any other equivalent software on the host OS.	**2**
3.	Study of the features of firewall in providing network security and to set firewall security in windows.	**4**
4.	Generating password hashes with OpenSSL.	**2**
5.	Perform a wireless audit of an access point / router and decrypt WEP and WPA.	**4**
6.	Setup a honey pot and monitor the HoneyPot on network	**4**
7.	Analysis of the security vulnerabilities of e-commerce services.	**4**
8.	Case Study on Authentication and Encryption.	**2**

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Subject Code: LMCS-134
Subject Name: DATA SCIENCE LABORATORY

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**70%
External Marks: 20	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 50	**Course Status:** Elective-3

Prerequisites: Data Mining Techniques
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Use the various data collection and data analysis techniques.
2.	Use R tool for data analytics science.
3.	Implement K-means clustering, Linear Regression, and Logistic Regression.
4.	Implement Naïve Bayesian classifier and Decision Trees.
5.	Use Simulation tools for Data science and analysis.

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	To study and use various Data collection techniques.	**2**
2.	To study and Implement K-means Clustering.	**4**
3.	To use Linear Regression and Logistic Regression.	**4**
4.	To implement Naive Bayesian Classifier.	**4**
5.	To implement Decision Trees.	**2**
6.	To study simulation tools for data science and analysis.	**4**
7.	Case studies in Data Science: Data Science for Sports Analytics / Drug Discovery / Placement Analytics etc.	**4**

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2019 Admission Batch Onwards

Subject Code: LMCS-135
Subject Name: WEB CRAWLER AND SEARCH ENGINES LABORATORY

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**70%
External Marks: 20	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 50	**Course Status:** Elective-3

Prerequisites: Web technologies
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Analyze the basic concepts of the Internet, the Web and online communication.
2.	Design a search engine architecture based on input design requirements.
3.	Apply different ranking algorithms and Classify the characterstics of web crawling and document fetching.
4.	Evaluation of search engines through W3C standards.
5.	Compare, and contrast different clustering methods

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	Create a website with navigation and multiple pages.	**2**
2.	Crawling the Web using WebS PHINX.	**4**
3.	To submit web pages in different search engine platforms.	**2**
4.	Indexing and retrieval of web pages.	**2**
5.	Application of ranking algorithms on web pages.	**2**
6.	Apply delta encoding technique on web pages.	**2**
7.	Classify the exact results of k-nearest neighbour algorithm.	**4**
8.	Perform W3C semantic web activity.	**2**
9.	Working with Google Web Master tool.	**4**

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Subject Code: LMCS-136
Subject Name: SOFTWARE TESTING AND QUALITY ASSURANCE LABORATORY

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**70%
External Marks: 20	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 50	**Course Status:** Elective-3

Prerequisites: Software Engineering
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Design and construct the manual test cases for different software module.
2.	Construct the test cases in automation testing tool.
3.	Create test strategies and plans, design test cases, prioritize and execute them.
4.	Implement real world applications using various software paradigms
5.	Contribute to efficient delivery of software solutions and implement improvements in the software development processes.

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	Understand Automation Testing Approach and by using Selenium IDE, Write a test suite containing minimum 4 test cases.	**4**
2.	Conduct a test suite for any two web sites.	**2**
3.	Install Selenium server and demonstrate it using a script in Java/PHP.	**2**
4.	Write and test a program to login a specific web page.	**2**
5.	Write and test a program to update 10 student records into table into Excel file.	**2**
6.	Write and test a program to provide total number of objects present / available on the page.	**2**
7.	Write and test a program to get the number of list items in a list / combo box.	**2**
8.	Take any system (e.g. ATM system) and study its system specifications and report the various bugs.	**4**
9.	To perform Software Audit (Checklist and Template-based) for the software developed and improve the Code Quality.	**2**

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Subject Code: LMCS-103
Subject Name: ADVANCE ALGORITHMS LABORATORY

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 50	**Course Status:** Core

Prerequisites: Data Structures
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Identify the problem given and find its solution using various algorithm design techniques.
2.	Compute time and space complexities of various algorithms.
3.	Implement algorithm design techniques such as Greedy approach, Dynamic programming to solve shortest path problems.
4.	Implement string matching algorithm for various applications like search engine queries, matching DNA sequences etc.
5.	Compare and contrast the performance of various algorithms for same problem.

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	Implement various sorting algorithms on given set of elements and determine their complexity.	**4**
2.	Print all the nodes reachable from a given starting node in a digraph using Breadth First Search and Depth First Search method.	**2**
3.	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.	**2**
4.	Solve rod cutting problem using recursion and bottom up approach.	**2**
5.	Implement Bellman-Ford algorithm problem using Dynamic Programming.	**2**
6.	Implement all pairs shortest path for a graph using Floyd-Warshall algorithm.	**2**
7.	Implement Prim's and Kruskal's algorithm to generate minimum cost spanning tree using Greedy approach.	**2**
8.	Make use of Ford-Fulkerson algorithm to compute maximum flow.	**2**
9.	Implement any string matching algorithm.	**2**
10.	Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.	**4**

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Subject Code: LMCS-104
Subject Name: SOFT COMPUTING LABORATORY

Programme: M.Tech.(CSE)	**L:** 0 **T:** 0 **P:** 2
Semester: 2	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**80%
External Marks: 20	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 50	**Course Status:** Core

Prerequisites: NIL
Additional Material Allowed in ESE: Nil
On completion of the course the student will have the ability to:

CO #	Course Outcomes
1.	Recognize the feasibility of applying a soft computing methodology for a particular problem
2.	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
3.	Apply genetic algorithms to combinatorial optimization problems
4.	Apply neural networks to pattern classification and regression problems
5.	Effectively use existing software tools to solve real problems using a soft computing approach

Detailed Contents:

Sr. No.	Name of Practical	No. of Hours
1.	Generate AND, OR and NOT functions using McCulloch-Pitts neural net.	**2**
2.	Design and implementation of neural network with Back Propagation Algorithm.	**2**
3.	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.	**3**
4.	Write a program to plot various membership functions.	**2**
5.	Create a Hebb Net to classify two dimensional input patterns in bipolar with given targets.	**2**
6.	Implement Travelling Salesman Problem using Genetic Algorithm.	**3**
7.	Implement FIS Editor.	**3**
8.	Develop a Kohonen's self organizing neural network to classify the following patterns into required number of groups. The number of groups should be flexible and may change according to the input data set. X1= [1 2 3 4 5] X2= [1.1 2.1 3.1 4.1 5.1] X3= [2 3 4 5 6] X4= [2.1 3.1 4.1 5.1 6.1] X5= [3 4 5 6 7] X6 = [3.1 4.1 5.1 6.1 7.1]	**3**
9.	Real world application solving: Identifying real word NP problem (Optimization / Forecasting / Classification / Clustering). Solving the problem with single / hybrid soft computing methods.	**4**