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-XXX	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 Range Searching, 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, Image sampling 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, Logical Operations, 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.

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**
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)	**4**
Philosophy of the Indian Constitution: Preamble Salient Features	
Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	**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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