COURSE STRUCTURE

M.TECH

COMPUTER SCIENCE & ENGINEERING

Under

Choice Based Credit System (CBCS)

First Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSC0001	Theory of Computation	4	0	0	4	4
2.	MCSC0002	Software Engineering Methodologies	4	0	0	4	4
3.	MCSC0003	Advanced Concepts in Data Mining	4	0	0	4	4
4.	MCSC0004	Advanced Concepts in Networking	4	0	0	4	4
5.	MCSC0005	Probability and Stochastic Processes	4	0	0	4	4
PRACTICALS							
1.	MCSC0800	Problem Solving Lab - I	0	0	2	1	2
2.	MCSC0801	Seminar-I	0	0	2	1	2
		TOTAL	**20**	**0**	**4**	**22**	**24**

Second Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSC0006	Mobile Ad-hoc Networks	4	0	0	4	4
2.	MCSC1007	Artificial Intelligent and Expert Systems	4	0	0	4	4
3.	MCSC0008	Information Retrieval	4	0	0	4	4
4.	MCSC0009	Image Processing and Analysis	4	0	0	4	4
5.	MCSC0010	Design of Distributed Systems	4	0	0	4	4
PRACTICALS							
1.	MCSC0802	Problem Solving Lab - II	0	0	2	1	2
2.	MCSC0803	Image Processing and Analysis Lab	0	0	2	1	2
3.	MCSC0804	Seminar-II	0	0	2	1	2
		TOTAL	**20**	**0**	**6**	**23**	**26**

Third Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.		Elective-I	4	0	0	4	4
2.		Elective - II	4	0	0	4	4
3.	MCSJ0950	Dissertation – I	0	0	-	4	
4.	MCSC0805	Colloquium	0	0	2	1	2
		TOTAL	**20**	**0**	**2**	**13**	**10**

Fourth Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSJ0951	Dissertation – II	0	0	-	14	-

Program Elective

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSE0001	Computer Vision	4	0	0	4	4
2.	MCSE0002	Wireless Sensor Networks	4	0	0	4	4
3.	MCSE0003	Software and Service Oriented Architecture	4	0	0	4	4
4.	MCSE0004	Pattern Recognition	4	0	0	4	4
5.	MCSE0005	High Performance Computing	4	0	0	4	4
6.	MCSE0006	Web Mining	4	0	0	4	4
7.	MCSE0007	Machine Learning	4	0	0	4	4

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK
			L	T	P	J		
1.	MCSJ0950	Dissertation – I	0	0	0	0	4	-
2.	MCSJ0951	Dissertation – II	0	0	0	0	14	-
TOTAL			**0**	**0**	**0**	**0**	**18**	**0**

COURSE STRUCTURE
M.TECH (CSE)
PART TIME

First Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSC0001	Theory of Computation	4	0	0	4	4
2.	MCSC0002	Software Engineering Methodologies	4	0	0	4	4
3.	MCSC0005	Probability and Stochastic Processes	4	0	0	4	4
PRACTICALS							
1.	MCSC0800	Problem Solving Lab - I	0	0	2	1	2
2.	MCSC0801	Seminar-I	0	0	2	1	2
		TOTAL	**12**	**0**	**4**	**14**	**16**

Second Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSC1007	Artificial Intelligent and Expert Systems	4	0	0	4	4
2.	MCSC0009	Image Processing and Analysis	4	0	0	4	4
3.	MCSC0010	Design of Distributed Systems	4	0	0	4	4
PRACTICALS							
1.	MCSC0802	Problem Solving Lab - II	0	0	2	1	2
2.	MCSC0803	Image Processing and Analysis Lab	0	0	2	1	2
		TOTAL	**12**	**0**	**4**	**14**	**16**

Third Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSC0003	Advanced Concepts in Data Mining	4	0	0	4	4
2.	MCSC0004	Advanced Concepts in Networking	4	0	0	4	4
3.		Elective	4	0	0	4	4
		TOTAL	**12**	**0**	**0**	**12**	**12**

Fourth Semester

S. No.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	Contact Hrs/wk
			L	T	P		
1.	MCSC0006	Mobile Ad-hoc Networks	4	0	0	4	4
2.	MCSC0008	Information Retrieval	4	0	0	4	4
3.		Elective	4	0	0	4	4
PRACTICALS							
1.	MCSC0804	Seminar-II	0	0	2	1	2
		TOTAL	**12**	**0**	**2**	**13**	**14**

Fifth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK
			L	T	P	J		
1.	MCSJ0950	Dissertation – I	0	0	0	0	4	-
2.	MCSC0805	Colloquium	0	0	2	0	1	0
TOTAL			**0**	**0**	**0**	**0**	**5**	**0**

Sixth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK
			L	T	P	J		
1.	MCSJ0951	Dissertation – II	0	0	0	0	14	-
TOTAL			**0**	**0**	**0**	**0**	**14**	**0**

SYLLABUS

MCSC0001: THEORY OF COMPUTATION

Objective: *Make students understand the fundamental questions of computer science:*

- *What problems can be solved by a computation?*
- *How hard is it to compute solutions?*
- *How can we express computation?*
- *Develop students' ability to understand and conduct mathematical proofs for computation and algorithms.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	Chomsky Hierarchy of Grammars and the corresponding acceptors, Decidability – Decidable languages, The Halting Problem, Undecidable Problems about Turing Machines, Post's Correspondence Problem, Reducibility, Self-reference and the Recursion Theorem. **Complexity theory** - Measuring Complexity, Nontrivial examples of polynomial-time algorithms, The concept of a reduction, P, NP, and NP-completeness; the Cook-Levin Theorem, The P versus NP problem and why it's hard.	26
II	**Introduction to Cryptography** - Perfect secrecy and its limitations, Computational Approach to Cryptography, Computational security, one-way functions and pseudorandom generators, Pseudorandom generators from one-way permutations. Probabilistic Turing machines and their examples, One-sided and "zero-sided" error: RP, coRP, ZPP. Trapdoor one-way functions, Zero Knowledge Proofs, some applications - Pseudorandom functions, tossing coins over the phone and bit commitment, Secure multiparty computations, Lower bounds for machine learning. Probably approximately correct (PAC) learning, Introduction to Quantum, Quantum Mechanics and BQP.	26

References:

- Moore, Cristopher and Stephan Mertens , " The Nature of Computation. Oxford University Press" , 2011. ISBN: 9780199233212.
- Sipser, Michael, "Introduction to the Theory of Computation" , 2005. ISBN: 9780534950972.
- Arora, Sanjeev, and Boaz Barak. "Computational Complexity": A Modern Approach. Cambridge University Press, 2009. ISBN: 9780521424264.

Outcomes:

On successful completion of this course, students should be able to:

- CO1: Design, manipulate, and reason about formal computational models.
- CO2: Describe the limitations of different types of computing devices.
- CO3: Identify relations between classes of computational problems, formal languages, and computational models
- CO4: Account for the inherent complexity of many computational problems of practical importance
- CO5: Conduct formal reasoning about machines, problems and algorithms, including reduction-based proof

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2 /PSO2, PSO3
CO2	PO5, PO8, PO9, PO11/ PSO4
CO3	PO3, PO4, PO5, PO11/ PSO1
CO4	PO6, PO7, PO8, PO10/ PSO3, PSO4
CO5	PO1, PO3, PO12/ PSO4

MCSC0002: SOFTWARE ENGINEERING METHODOLOGIES

Objective: *To understand the concepts and methods required for the development of large software intensive systems. Further, to provide an account of validation of various systems through formal methods.*

Credits:04 **Semester I** **L–T–P :4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Motivation – Software Attributes – Complexity - Software Metrics- Software Process, Requirement Engineering, Formal requirement specification, requirement modeling and specification Design Metrics and Configuration Management. Formal Specification and program verification, Software Process, Requirement Engineering, **Software Design Patterns** Issues in software design: modularity based cohesion & coupling Function oriented analysis & design. Software Architecture description languages - Product-line architectures; Component based development	26
II	**Software Quality Engineering** Testing Techniques – Test Case Generation, Software Maintenance schemes Software testing: strategies and assessment, COTS, Software reliability metrics & modeling, Software quality: models and assurance framework, Software Maintenance. **Introduction to formal methods** Formal Specifications Techniques – Verification and Validation – Theorem Provers - Model checking – Temporal logics – CTL & LTL and model checking **Software Metrics** - COTS Integration - Distributed, Internet-scale and Web-based Software Engineering **Empirical Studies of Software Tools and Methods** Software Reengineering - Software Reuse - Software Safety - Enterprise Architectures, Zachman's Framework; Architectural Styles.	26

References:

- Ghezzi, Jazayeri, Mandrioli, "Fundamentals of Software Engineering", 2/E,Pearson ducation, 2002.
- Ian Sommerville , "Software Engineering", 6/E,Pearson Education, 2006
- Roger S Pressman , "Software Engineering – A Practitioner's Approach" ,6/E,MGH, 2005.
- Schmidt, Stal, Rohnert, and Buschmann , "Pattern-Oriented Software Architecture" Volume 2: Patterns for Concurrent and Network ed Objects",Wiley, 2000.
- Len Bass, Paul Clements, Rick Katzman, Ken Bass , "Software Architecture in Practice", 2/E, Addiwon –WesleyProfessional, 2003.

Course Outcomes:

- CO1: Develop, maintain and evaluate large-scale software systems
- CO2: Produce efficient, reliable, robust and cost-effective software solutions
- CO3: Critically evaluate assumptions and arguments
- CO4: Apply the principles, tools and practices of IT project management
- CO5: Manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals
- CO6: Understand and meet ethical standards and legal responsibilities
- CO7: Rapidly learn and apply emerging technologies
- CO8: Understand the basic models of Software Quality and maintenance.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO11/ PSO1, PSO2
CO2	PO3, PO4, PO11/ PSO2, PSO3
CO3	PO4, PO5 / PSO3, PSO4
CO4	PO5, PO8, PO9, PO11 / PSO4
CO5	PO3, PO4, PO5, PO11/ PSO1
CO6	PO6, PO7, PO8, PO10 / PSO3, PSO4
CO7	PO1, PO3, PO12/ PSO4
CO8	PO1, PO2, PO11/ PSO3

MCSC0003: ADVANCED CONCEPTS IN DATA MINING

Objective:

- *To understand the advanced principles, concepts and applications of data mining*
- *To introduce the task of data mining as an important phase of knowledge recovery process.*
- *Analyze the data for various applications.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction of Data Mining:** Fundamentals, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Data Mining Primitives. **Association Rules:** Basic Concepts, Apriori Algorithm, Data Formats for Association Rule Mining, Mining with Multiple Minimum Supports- Extended Model and Mining Algorithm, Mining Class Association Rules- Problem Definition and Mining Algorithm. **Sequential Patterns:**Basic Concepts,Mining Sequential Patterns Based on GSP, GSP Algorithm, Mining Sequential Patterns Based on PrefixSpan- PrefixSpan Algorithm, Generating Rules from Sequential Patterns-Sequential Rules and Label Sequential Rules. **Supervised Learning:**Basic concepts. **Decision Tree Induction**: Learning Algorithm, Impurity Function, Classifier Evaluation- Evaluation Methods, Precision, Recall, F-score and Breakeven Point. **Classification Based on Associations:** Classification using Class Association rules, Class Association Rules as Features,	20
II	**Naïve Bayesian Classification**: Basic Concepts, Naïve Bayesian Text Classification,Probabilistic Framework, Naïve Bayesian Model. **Support Vector Machines**: Linear SVM, Nonlinear SVM, K-Nearest Neighbor Learning. **Unsupervised Learning:** Basic Concepts, K-means Clustering- K-means Algorithm, Disk Version of the K-means Algorithm. Representation of Clusters-Common Ways of Representing Clusters and Clusters of Arbitrary Shapes. **Hierarchical Clustering:** Single-Link Method, Complete-Link Method. **Distance Functions:** Numeric Attributes, Binary and Nominal Attributes, Text Documents, Data Standardization. Handling of Mixed Attributes,Which Clustering Algorithm to Use, Cluster Evaluation. **Partially Supervised Learning:** Learning from Labeled and Unlabeled Examples,EM Algorithm with Naïve Bayesian Classification,Co-Training, Self-Training.	20

References:

- Bing Liu, "Web Data Mining", First Edition,Springer, 2007.
- Jiawei Han and. Micheline Kamber "Data Mining – Concepts and Techniques", 3rd Edition Morgan Kaufmann, 2003.
- Arun K Pujari , "Data Mining Techniques", 2nd Edition University Press, 2010

Outcomes:

- On successful completion of this course, students should be able to:
- CO1: Understand the concept of data warehouse and data mining.
- CO2: Apply the concept of data warehouse and data mining in real-life applications.
- CO3: Apply the principle algorithms used in modern machine learning.
- CO4: Apply the information theory and probability theory to get the basic theoretical results in Advanced Data Mining.

- CO5: Apply Advanced Data mining algorithms to real datasets, evaluate their performance and appreciate the practical issues involved.
- CO6: Implement supervised algorithms on data set.
- CO7: Implement unsupervised algorithms on data set.
- CO8: Implement ensemble based algorithms on data set.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2 /PSO1
CO2	PO3/PSO4
CO3	PO4/PSO3, PSO4
CO4	PO2/PSO3, PSO4
CO5	PO5/PSO4
CO6	PO2, PO5/PSO4
CO7	PO2, PO5/PSO4
CO8	PO2, PO5/PSO4

MCSC0004: ADVANCED CONCEPTS IN NETWORKING

Objective: To make students understand the protocols, algorithms and tools needed to support the development and delivery of advanced network services over networks.

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Networking overview, MAC layer issues, Ethernet 802.3, ARP, IP addressing and Subnetting, NAT and PAT, Variable Length Subnet Masking, CIDR **Advanced routing in the Internet and traffic engineering:** Intra domain routing: OSPF and IS-IS, Inter domain routing: BGP, Traffic Engineering **MPLS network**: MPLS basics, MPLS signaling, MPLS VPN **Internet multicasting:** IP multicasting, Application layer (Overlay) multicasting **TCP connection establishment and termination**: Sliding window concepts, other issues: wrap around, silly window syndrome, Nagle's algorithm, adaptive retransmission, TCP extensions. **End-to-End Congestion Control:** Tahoe, Reno, Vegas,	25
II	**Network based congestion control:** RED and ECN, Multicast congestion control. **Multimedia networking:** Introduction to multimedia networking, Video streaming over the Internet. **Internet QoS:** QoS fundamentals, Internet Differentiated services, Internet Integrated Services. **Peer-to-Peer networks and applications:** Peer-to-Peer file sharing networks, Peer-to-Peer streaming networks, Concept of overlays, Unstructured Overlays: Gnutella, Concepts of Distributed Hash Table, Structured Overlays: Chord, CAN, Pastry. **Wireless mobile networks:** Introduction to wireless networks, Wireless LAN, Cellular Networks, Mobile IP	25

References:

- Peterson and Davie ,"Computer Networks: A Systems Approach", 5th Edition MorganKauffman, 2011.
- Kurose and Ross ,"Computer Networking: Top Down Approach", 6th Edition. PearsonEducation, 2011.

Reading List

- V. Paxson, "End – to - end Internet packet dynamics," in IEEE/ACM Transactions on Networking, Vol. No. 3,June, 1999.
- W. Stevens, "TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms,"RFC2001.
- K.Fall and S. Floyd, "Simulation - based comparison of Tahoe, Reno, and SACK TCP," Computer Communication Review, vol. 26, pp. 5 - 21, July1996.
- L. Brakmo and L. Peterson, " TCP Vegas: End – to - End Congestion Avoidance on a Global Internet," IEEE Journal on Selected Areas in Communications, 13(8), October 1995, 1465 -- 1480.
- A. Rowstron, P. Druschel,"Pastry: Scalable, decentralized object location and routing for large - scale peer – to - peer systems". Middleware, 2001, 329—350.

Outcomes: After the completion of the course, the student will be able to:

- CO1: Understand and explain Data Communications System and its components.
- CO2: Identify the different types of network devices and their functions within a network.
- CO3: Understand and building the skills of subnetting and routing mechanisms.

- CO4: Differentiate among flow control, congesting control and congestion avoidance.
- CO5: Demonstrate the different congestion control mechanism.
- CO6: Calculate congestion window size (cwnd) in TCP congestion mechanism.
- CO7:Understand and analyze the challenges of P2P networks and wireless networks.
- CO8: Explain the limitations of wireless networks.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2,PO3/PSO1,PSO2
CO2	PO1,PO2,PO3,PO4/PSO1,PSO2
CO3	PO1,PO2,PO3,PO4/PSO1,PSO4
CO4	PO1,PO2,PO3,PO6/PSO1,PSO4
CO5	PO1,PO2,PO3/PSO1,PSO4
CO6	PO1,PO2,PO3,PO4/PSO1,PSO4
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO3

MCSC0005: PROBABILITY & STOCHASTIC PROCESSES

Objective: *To introduce the concepts of probability and stochastic processes and illustrate these concepts with engineering applications to support other courses and research in computer engineering.*

Credits: 04 **Semester I** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I.	**Basic Probability:** Introduction, definitions of probability, set theory, axioms of probability, Conditional probability, Total probability and Bayes' theorem. **Random Variables:** Definition, Cumulative Distribution Function (CDF), continuous, discrete and mixed Random Variables, Probability Density Function (PDF), Probability Mass Function (PMF). **Properties of Random Variables:** Moments of Random variables: Mean and variance of random variable, Coefficients of variation, Skewness and kurtosis, Moments, Covariance and correlation coefficient. Properties of Distribution Functions,	21
II.	**Specific Random Variables:** Gaussian, Exponential, Rayleigh, Uniform, Binomial and Poisson Distributions. **Hazard Rate:** Definition, hazard rate of Exponential distribution, Gamma distribution, Weibull distribution. **Stochastic Processes:** Definition and Classification of Stochastic Processes, Poisson process, Birth and Death Process, Applications to Queues, Discrete Time Markov Chains, Limiting Distributions – Theory of M/M/1 and M/M/m queues – Little's Theorem	22

Text Books:

- Kishore S. Trivedi, "Probability and Statistics with Reliability, Queuing and Computer Science Applications" Wiley

Reference Books:

- Papoulis, S. U. Pillai, "Probability, Random Variables and Stochastic Processes", Tata McGraw Hill
- A L Garcia, "Probability and Random Process for Electrical Engineers", Pearson Education
- R. M. Gray, L. D. Davisson , "An Introduction to Statistical Signal Processing", Cambridge University Press, 2004.
- H. Stark and J. W. Woods, "Probability and Random Processes with Applications to Signal Processing ", Pearson Education.
- P.Z. Peebles, "Probability, Random variables and Random signal principles", Tata McGraw Hill
- S L Miller, D G. Childers, "Probability and Random Processes", Academic press.
- Y. Viniotis, "Probability and Random Processes for Electrical Engineers", McGraw Hill.

Outcome: After completion of course, the student will be able to:

- CO1: have a general overview of statistical methods.
- CO2: know the principle definitions, fundamental theorems, and important relationships in statistics.
- CO3: Understand the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.
- CO4: Understand how random variables and stochastic processes can be described and analyzed
- CO5: Characterize probability models and function of random variables based on single & multiples random variables.

- CO6: understand the role of probability theory as well as the concept of random variables and stochastic processes in information and communication technology.
- CO7: having competence in applying statistical methods to solve basic problems in information and communication technology.
- CO8: Understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity and ergodicity.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2 /PSO1
CO2	PO1, PO2 /PSO1, PSO2
CO3	PO4, PO5,PO6 /PSO3
CO4	PO2, PO3, PO4 /PSO1, PSO3
CO5	PO4, PO5, PO6 /PSO1, PSO3
CO6	PO3, PO4,PO5 /PSO1
CO7	PO5, PO6 /PSO3
CO8	PO1, PO2 /PSO1

MCSC0006: MOBILE AD-HOCNETWORKS

Objective: *This course will enable the students to understand the detailed concept related to Mobile Ad-hoc Networks.*

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Ad Hoc Wireless Networks:** Issues in Ad Hoc Wireless Networks, Ad Hoc Wireless Internet; **MAC Protocols for Ad Hoc Wireless Networks:** Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols; **Routing Protocols for Ad Hoc Wireless Networks:** Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Power Aware Routing Protocols.	26
II	**Transport Layer:** Issues and Design Goals, Split TCP, Ad-Hoc TCP, TCP-Bus Key Management. Secure Routing in Ad Hoc Wireless Networks **Energy Management in Ad Hoc Wireless Networks**: Classification of Energy Management Schemes, Transmission Power Management Schemes, System Power Management Schemes. **QoS in Ad-hoc Networks**: Issues, PHY, MAC, Network Layer Solutions Cross Layer Design	26

References:

- C S. Ram Murthy, B. S. Manoj ,"Ad Hoc Wireless Networks: Architectures and Protocols", Second Edition, Prentice Hall of India, 2005.
- R. Hekmat, "Ad hoc Networks: Fundamental Properties and Network Topologies", First Edition, Springer, 2006.
- B. Tavli and W. Heinzelman ,"Mobile Ad Hoc Networks: Energy Efficient Real Time Data Communications", First Edition, Springer, 2006.
- G. Anastasi, E. Ancillotti, R. Bernasconi, and E. S. Biagioni ,"Multi Hop Ad Hoc Networks from Theory to Reality", Nova Science Publishers, 2008.

Outcomes:

At the end of this course the students will be able to:

- CO1: Understand the need for ad hoc networks.
- CO2: Explain the constraints of physical layer that affect the design and performance of ad hoc network.
- CO3: Understand the concepts of protocols required for wired network may not work for wired network at MAC, Network and Transport Layer.
- CO4: Explain the operations and performance of different MAC layer protocols.
- CO5: Explain the different routing protocols proposed for ad hoc networks.
- CO6: Understand the basics of unicast and multicast routing protocols.
- CO7: Understand security issues and QoS requirements in MANETs.
- CO8: Explain about the energy management in adhoc networks.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2,PO3/PSO1,PSO2
CO2	PO1,PO3,PO4/PSO1,PSO2
CO3	PO1,PO3,PO4/PSO1,PSO4
CO4	PO1,PO2,PO3/PSO1,PSO4
CO5	PO1,PO2/PSO1
CO6	PO1,PO3,PO4/PSO1,PSO4
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO3

MCSC1007: ARTIFICIAL INTELLIGENT AND EXPERT SYSTEMS

Objective: *The learning objectives of this course are to acquaint students with theory and principles of intelligent systems and with representative practical systems.*

Credits: 4 **Semester: II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	**Introduction to Artificial Intelligence-** Introduction to AI, Cattell – Horn – Carroll (C-H-C) theory of intelligence, Intelligent agents, Problem solving by searching, Informed search & Exploration – Heuristic search strategies (A * Search, AO* Search) Heuristic Functions, Hill climbing, Simulated Annealing search. Min – Max search, Alpha-Beta search for game playing. **Knowledge & Reasoning-** Propositional Logic, reasoning patterns in Propositional Logic, First order Logic, Inference in First order Logic – Unification & Lifting, Forward & backward chaining, resolution, Herbrand universe, Herbrand interpretation, semantic tree, prof procedure. **Knowledge Representation –** Ontological Engineering, Categories & Objects, Action, Situation & Events, semantic Networks. **Uncertainty –** Basic Probability notion, the Axiom's of probability, Bayes' Rule & its use. **Probabilistic reasoning -** Bayesian Networks, Exact & Approximate inference in Bayesian Networks,	20
II	**Artificial Neural Networks:** Introduction, Neuron Physiology, Artificial Neurons. Learning, Feed forward & feedback network, Training algorithms: Delta rule, Perceptron learning rules, Back propagation, RBFN, Deep learning, Meta Learning, Deep – Meta learning. **Expert System –** Introduction, Expert system: features, characteristics, development, activities, difference with conventional methods. **Genetic Algorithm –** Introduction to GA, representation, initialization and selection, Operations of GA, **Fuzzy Logic –** Introduction to Fuzzy logic, Fuzzy Sets, Classical Relations, Properties of Membership Function, Fuzzification, and Defuzzification, Logic and Fuzzy system, Approximate reasoning based on fuzzy Logic for control and classification problem.	20

References:

- Nils J Nilsson (1982)" Principles of Artificial Intelligence," Springer- Berlag.
- Chin-Liang Chang & Richards Char- Tung Lee (1973), "Symbolic logic and mechanical theorem Proving", academic press.
- Stuart Russell, Peter Norvig (2009)," Artificial Intelligence – A Modern Approach", Pearson
- Elaine Rich & Kevin Knight (1999)," Artificial Intelligence", TMH.2ND Edition
- NP Padhy(2010),"Artificial Intelligence & Intelligent System", Oxford
- ZM Zurada, "Introduction to Artificial Neural Systems", west Publishing Company
- Timothy J Ross (2004), "Fuzzy Logic with Engineering Applications", John Wiley & Sons Ltd.
- Kumar sankar ray (2014) "Soft computing and its applications : volume I,II, Apple academic press and CRC Press.
- J Ross (2004), "*Fuzzy Logic with Engineering Applications*", John Wiley & Sons Ltd.

Outcomes:

At the end of this course the students will be able to:

- CO1: Describe the Basic concepts of artificial Intelligence including searching techniques.

- CO2: Design Knowledge base to implement artificial Intelligence.
- CO3: Develop model based on probability theory.
- CO4: Understand different training Algorithm.
- CO5: Solve the problems of artificial intelligence using artificial neural networks.
- CO6: Understand Expert Systems and its components.
- CO7 : Understand GA with its applications in different areas
- CO8: Understand the Fuzzy logic and its applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2,PO3/PSO1,PSO2
CO2	PO1,PO3,PO4/PSO1,PSO2
CO3	PO1,PO3,PO4/PSO1,PSO4
CO4	PO1,PO2,PO3/PSO1,PSO4
CO5	PO1,PO2/PSO1
CO6	PO1,PO3,PO4/PSO1,PSO4
CO7	PO1,PO2/PSO1
CO8	PO1,PO2/PSO3

MCSC0008: INFORMATION RETRIEVAL

Objective: *Introduce students to the basic concepts and techniques Web Mining for extracting knowledge from the web.*

Credits: 04 **Semester III** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Concepts, Retrieval Process **Modeling** – A Formal Characterization of IR Models, Classic Information Retrieval (Boolean model, Vector Model, Probabilistic Model), Alterative Set Theoretic Models, Alternative Algebraic Models (Generalized Vector Space Model, Latent Semantic Indexing Model). **Query Languages and Operations**: Keyword based Querying, Pattern Matching, Structural Queries, and User Relevance Feedback. Text Operations: Document Pre-processing, Document Clustering, Text Compression.	26
II	**Evaluation in Information Retrieval:** Retrieval Performance Evaluation Recall, Precision, Mean average Precision, F-Measure, User Oriented Measures, Discounted Cumulated Gain. TREC Web Collections. **Searching the Web:** Characterizing the web, Crawling the Web, Mercator: A Scalable, Extensible Web Crawler, Parallel Crawlers, Different Types of Web Crawler, Anatomy of a Large-Scale Hyper textual Web Search Engine, Page Rank Algorithm. **IR Applications:** Summarization and Question Answering	26

References:

- Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval",Second Edition, Addison Wesly, 2011.
- G. G. Chowdhury , "Introduction to Modern Information Retrieval", Second Edition, Neal-Schuman Publishers, 2003.
- David A. Grossman, Ophir Frieder, "Information Retrieval: Algorithms, and Heuristics", Springer, 2004

Outcomes: At the end of this course the students will be able to:

- **CO1:** Gain an understanding the basic concepts and techniques in Information Retrieval
- **CO2:**Apply different information retrieval techniques in real life applications.
- **CO3:** Understand the issues involved in representing and retrieving documents.
- **CO4:**Understand the latest technologies for linking, describing and searching the Web. - Understand the relationship between IR, hypermedia, and semantic models.
- **CO5:**Be able to apply and implement techniques for the preprocessing needed for information retrieval systems and can be able to develop a small information retrieval system.
- **CO6:**Apply the different evaluation strategies to the retrieved results for computing the efficiency and accuracy of the information retrieval model.
- **CO7:**Apply IR techniques to XML retrieval and develop retrieval system for web search tasks
- **CO8:**Demonstrate similarity computation for document retrieval.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2 /PSO2, PSO3
CO2	PO1,PO3/PS1,PS3
CO3	PO2,PO3/PS2,PS3
CO4	PO1,PO3/PS1,PS2
CO5	PO1, PO2/PS2,PS3
CO6	PO1,PO2,PO3/PS2,PS3
CO7	PO1,PO3/PS1,PS3
CO8	PO2,PO3/PS1,PS2,PS3

MCSC0009: IMAGE PROCESSING AND ANALYSIS

Objective: *To cover the basic theory and algorithms that are widely used in digital image processing and analysis.*

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Digital Image Fundamentals:** Image sampling & quantization; Basic relationships between pixels, Some mathematical tools used in digital image processing. **Image perception:** Light, luminance, brightness and contrast, Human Visual System, Colour representation, Chromaticity diagram, Colour Coordinate Systems. **Image Enhancement:** Overview, Contrast Intensification, Smoothing, Sharpening, Basic intensity Transformation functions, Histogram processing, Spatial filters, Image Restoration **Image Transforms:** Discrete Fourier Transform, DCT Transform, KL Transform, Wavelet Transform. Image Enhancement in Frequency Domain	26
II	**Image Compression:** Fundamentals, Lossless Compression: Huffman Coding, Arithmetic Coding, Run-length Coding. Lossy Compression: JPRG Coding. **Image Registration:** Geometric Transformation, Registration by Mutual Information Maximization. **Image Analysis:** Fundamental concepts, Segmentation: Region extraction, Pixel based approach, Thresholding, Region based approach. Canny Edge Detection, **Feature Extraction:** Representation, Topological Attributes, Geometrical Attributes, Spatial Moments, Boundary based Description, Region based Description, and Intensity based Description. **Object Recognition:** Patterns and pattern classes, Recognition based on decision-theoretic methods, structural methods.	26

References:

- R. C. Gonzalez and R.E. Woods, "Digital Image Processing", Third Edition, Prentice Hall, 2011.
- Bhabatosh Chanda, D. Dutta Majumder, "Digital image processing and analysis**,** Second Edition, PHI, 2013.
- Anil K. Jain, "Fundamentals of Digital Image Processing"**,** Prentice-Hall, 2011.

Outcomes:

- CO1: Understand the need for image transforms and their properties.
- CO2: Develop any image processing application.
- CO3: Learn different techniques employed for the enhancement of images.
- CO4: Learn the spatial and frequency domain techniques of image compression.
- CO5: Learn different feature extraction techniques for image analysis and recognition
- CO6: Learn different causes for image degradation and overview of image restoration techniques.
- CO7: Analyze images in the frequency domain using various transforms.
- CO8: Implement the image processing techniques in real world problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2 /PSO2, PSO3
CO2	PO1,PO3/PSO1,PSO3
CO3	PO2,PO3/PSO2,PSO3
CO4	PO1,PO3/PSO1,PSO2
CO5	PO1, PO2/PSO2,PSO3
CO6	PO1,PO2,PO3/PSO2,PSO3
CO7	PO1,PO3/PSO1,PSO3
CO8	PO2,PO3/PSO1,PSO2,PSO3

MCSC0010: DESIGN OF DISTRIBUTED SYSTEMS

Objective: *To understand the fundamental principles, architectures, algorithms and programming models used in distributed systems and their extension in grid and cloud computing.*

Credits: 04 **Semester II** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction, Types, Design Issues, Models, Theoretical foundations of DS, Case Study of Amobea. **Distributed Mutual Exclusion:** Classification, Requirements, Performance Measurement, Non-Token Based Algorithm & Token Based Algorithm, Shared Memory based Mutual Exclusion **Communication in Distributed System:** Communication Between Distributed Objects, Events, Inter Process Communication- RPC, Distributed Objects and Middleware –Overview of trends. Challenges and Opportunities. **Distributed File Systems –**Introduction, Issues, Mechanism for building distributed file systems, Reliability & Performance in traditional DFS, Case Study – AFS, NFS, CODA **Failure Recovery:** Introduction, types, Recovery in concurrent and replicated distributed database system, Checkpoint Based Recovery **Fault Tolerance**: Issues, Commit Protocols, Voting Protocols	**26**
II	**Distributed Scheduling** – Issues in Load Distributing, Components, Stability, Load Distributing algorithm, Performance Comparison, Task Migration and issues **Distributed shared memory**-Architecture & Motivation, Memory coherence, Coherence Protocol, Design Issues Case Study- IVY **Distributed Web-Based Systems –** Architecture, Processes, Naming, Synchronization, Consistency and Replication **Distributed Coordination-Based Systems-** Introduction To Coordination Models, Architectures, Processes, Communication **Grid Computing –** Definition, Benefits, Issues, Types of Resources, Scheduling, reservation, and scavenging, Grid architecture models, Grid topologies, Case Study – Globus Toolkit **Cloud Computing –** Definition, Properties, Characteristics & Disadvantages, Cloud Computing Architecture, Service Models, Deployment Models, Resource Virtualization, Case Study – Amazon EC2	**26**

Text Book:

- Singhal & Shivaratri ,"Advanced Concept in Operating Systems", McGraw Hill, 2001

References:

- Coulouris, Dollimore, Kindberg , "Distributed System: Concepts and Design", Pearson Ed.Gerald Tel "Distributed Algorithms", Cambridge University Press, 2011.
- Tannenbaum , "Distributed Systems: Principles and Paradigms", Pearson Education, 2004.

Outcomes:

- CO1: Understand basic elements and concepts related to distributed system technologies; and core architectural aspects of distributed systems.
- CO2: Identify the designing principles of distributed algorithms for different primitives like mutual exclusion, deadlock detection, and agreement.
- CO3: Understand principle behind IPC and use various interposes communication techniques, such as remote method invocation, remote events for building distributed systems.
- CO4: Introduce the concepts of distributed file system with its architecture and components along with case studies.
- CO5: Distinguish the main failure types in a Distributed System and specify algorithms for achieving fault tolerance and error recovery within such a system.
- CO6: Understand how balancing of resources is done; issues, components and algorithms for load balancing in distributed environment.
- CO7: Applying Grid and Web based techniques to support Distributed Systems.

- C 8. Applying Cloud based techniques to support Distributed Systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO2/PSO3
CO3	PO1/PSO1
CO4	PO3/PSO2
CO5	PO1, PO2/PSO3
CO6	PO1, PO2/PSO1, PSO3
CO7	PO5/PSO4
CO8	PO5/PSO4

MCSE0001: COMPUTER VISION

Objective: *To introduce the principles, models and applications of computer vision. To develop an appreciation for various issues in the design of computer vision and object recognition systems*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Overview to Computer Vision, Image formation – Geometric primitives and transformations, Photometric Image formation. **Digital Camera:** Sampling & aliasing, Colour, Compression, Camera model & caliberation, Epipolar Geometry, Stereopsis. **2D Shape –** Hough transform, Shape numbers, Pyramids, Quad Trees, Medial Axix Transform. **Recognition:** Detectors and Descriptors, clustering (K-Mean and Mean Shift), Interest Point Detection, Harris Corner Detector, SIFT, Template Matching, Detection with sliding windows: Viola Jones, Object recognition (Eigenfaces, Active appearance models).	26
II	**Classification:** K-nearest Neighbours Algorithm, Statistical Classification, Bag-of-Words Models, Overview of methods for building Classifies, a part-based generative model (Constellation model) and a part-based discriminative model (Latent SVM). **Motion Analysis:** Motion estimation using Optic Flow, Video Change Detection, moving object detection - Background Subtraction approach, moving object detection using Gaussians Mixture Model (GMM) approach. Object Tracking, Kernel (Mean Shift) based Object Tracking, Motion Models to aid tracking (Kalman Filtering, particle filtering), Data Association, Applications of Object Tracking.	26

References:

- Richard Szeliski ,"Computer Vision: Algorithms and Applications", Springer, 2010.
- D.A. Forsyth and J. Ponce ,"Computer Vision: A Modern Approach", Prentice Hall, 2002
- Milan Sonka, Vaclav Hlavae, Roger Boyle , "Image Processing, Analysis and Machine Vision", Second Edition, Thomson, 2008.
- R. Hartley, and A. Zisserman ,"Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004
- R.O. Duda, P.E. Hart, and D.G. Stork ,"Pattern Classification" (2nd Edition), Wiley-Interscience, 2000

Outcomes:

- CO1: Understand the basic knowledge, and methods of human and computer vision systems.
- CO2: Identify, formulate and solve the image formation and image modelling process.
- CO3: Analyze, evaluate and test existing practical computer vision systems.
- CO4: Implement the working of live computer vision system effectively.
- CO5: Apply theoretical and practical knowledge to identify the novelty and practicality of proposed computer vision methods.
- CO6: Design and develop practical and innovative computer vision applications or systems.
- CO7: Able to conduct real implication image processing and deep learning methods.
- CO8: Analyze and design algorithms for computer vision applications.

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Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2/ PSO1
CO2	PO1,PO2,PO4/ PSO4
CO3	PO1,PO2,PO5/ PSO1,PSO3
CO4	PO3,PO4,PO5/ PSO4
CO5	PO3,PO4,PO5,PO6/ PSO1,POS4
CO6	PO3,PO4,PO5,PO6/ PSO1,POS4
CO7	PO1,PO4 / PSO4
CO8	PO2,PO3,PO4,PO6 / PSO3,PSO4

MCSE0002: WIRELESS SENSOR NETWORKS

Objective: *To make students understand the protocols, algorithms and tools needed to support the deployment and functionality of wireless sensor networks.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Applications and Design Model:** Examples of available sensor nodes, Sample sensor networks applications, Design challenges, Contemporary network architectures, Operational and computational models, Performance metrics, Software and hardware setups. **Network Bootstrapping:** Sensor deployment mechanisms, Issues of coverage, Node discovery protocols **Physical and Link layers:** Radio energy consumption model, Power Management, Medium access arbitration: Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, Optimization mechanisms **Localization and Positioning:** Properties of positioning, Possible approaches, Mathematical basics for the lateration problem, Single-hop localization, Positioning in multi-hop environments, Impact of anchor placement.	26
II	**Topology control:** Motivation and basic ideas, Flat network topologies, Hierarchical networks by dominating sets, Hierarchical networks by clustering, Combining hierarchical topologies and power control, Adaptive node activity. **Naming and Addressing:** Address and name management in wireless sensor networks, Assignment of MAC addresses, distributed assignment of locally unique addresses, Content-based and geographic addressing. **Routing protocols:** The many faces of forwarding and routing, Gossiping and agent-based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, Geographic routing, Coping with energy constraints, Mobile nodes. **Data-centric and content-based networking:** Introduction, Data-centric routing, Data aggregation, Data-centric storage. **Dependability Issues:** Security challenges, Threat and attack models, Quality of service provisioning, Time Synchronization: Introduction to the time synchronization problem, Protocols based on sender/receiver synchronization, Protocols based on receiver/receiver synchronization, Supporting fault tolerant operation.	26

References:

- Dorothea Wagner and Roger Wattenhofer , “Algorithms for Sensor and Ad Hoc Networks, Advanced Lectures”, Lecture Notes in Computer Science 4621, 2007.
- Waltenegus Dargie, Christian Poellabauer , “Fundamentals of Wireless Sensor Networks: Theory and Practice”, John Wiley & Sons , 2010.
- Carlos De Morais Cordeiro, Dharma Prakash Agrawal , “Ad Hoc and Sensor Networks: Theory and Applications”, World Scientific, 2011.
- Holger Karl, Andreas Willig , “Protocols and Architectures for Wireless Sensor Networks”, Wiley Publications, 2005.
- Cauligi S. Raghavendra, Krishna Sivalingam, Taieb M. Znati ,“Wireless Sensor Networks”, Springer, 2005.

Outcomes:

After the completion of the course, the student will be able to:

- CO1: Understand the basic concepts of wireless sensor networks, sensing, computing and communication tasks

- CO2: Understand the Sensor management, sensor network middleware, operating systems.
- CO3: Analyze the assess coverage and conduct node deployment planning,
- CO4: Devise appropriate data dissemination protocols and model links cost,
- CO5: Determine suitable medium access protocols and radio hardware.
- CO6: Understand the architectures, features, and performance for wireless sensor network systems and platforms
- CO7: Identify quality of service, fault-tolerance, security and other dependability requirements and conduct trade-off analysis between performance and resources.
- CO8: Evaluate the performance of sensor networks and identify bottlenecks.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1, PO2, PO7 /PSO1
CO2	PO1, PO4/PSO2, PSO3
CO3	PO1, PO2, PO4/PSO3, PSO4
CO4	PO1/PSO2
CO5	PO2, PO3/PSO4
CO6	PO1/PSO3
CO7	PO1, PO3/PSO3, PSO4
CO8	PO1, PO7/PSO3

MCSE0003: SOFTWARE AND SERVICE ORIENTED ARCHITECTURE

Objective: *To understand basic concepts, theories, and techniques used in service-oriented architecture, along with governance strategies and trends in SOA.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Software Architecture – Types of IT Architecture, SOA Evolution, Key components, perspective of SOA, Enterprise-wide SOAArchitecture, Enterprise Applications, Solution Architecture for enterprise application Software platforms for enterprise Applications, Patterns for SOA, SOA programming models. Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services. Technologies of SOA – SOAP, WSDL. Service integration with ESB	26
II	Web Services and Contemporary SOA- Message exchange patterns, Service activity, coordination. Atomic transactions, Business activities, Orchestration and Choreography- Issues Introduction to XML – Overview and Security. Introduction to Web Services and Security, SOA implementation and Governance strategy , trends in SOA, event-driven architecture, software as a service. SOA Delivery Strategies- SOA delivery lifecycle phases. Transaction processing – paradigm, protocols and coordination, transaction specifications, SOA in mobile, research issues in SOA	26

References:

- Shankar Kambhampaly ,"Service –Oriented Architecture for Enterprise Applications", Wiley India Pvt. Ltd, 2008.
- Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", PearsonEducation.
- Mark O' Neill, et al , "Web Services Security",Tata McGraw-Hill Edition, 2003.
- Thomas Erl , " Service-Oriented Architecture: Concepts, Technology & Design", Pearson Education Pvt. Ltd, 2008.
- Thomas Erl ,"SOA Principles of Service Design", Pearson Exclusives, 2007.
- Thomas Erl and Grady Booch, "SOA Design Patterns", Prentice Hall, 2008.

Outcomes:

After the completion of the course, the student will be able to:

- CO1: Understand primary concepts of SOA
- CO2: Design the software Platforms using SOA
- CO3: Understand Web Services and Contemporary SOA
- CO4: Understand Security issues of SOA
- CO5: Implement XML in designing SOA
- CO6: Know the integration of SOA technological points with Web Services.
- CO7: Implement SOA in development cycle of Web Services
- CO8: Implement SOA in Transaction Processing

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2 /PSO1
CO2	PO3/PSO2
CO3	PO1/PSO1
CO4	PO1/PSO1
CO5	PO5/ PSO4
CO6	PO5/PSO4
CO7	PO5/PSO4
CO8	PO5/PSO4

MCSE0004: PATTERN RECOGNITION

Objective: *Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test. **Statistical Patten Recognition:** Bayesian Decision Theory, Classifiers, Normal density and discriminant functions,	26
II	**Parameter estimation methods:** Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models. **Nonparametric Techniques:** Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification. **Unsupervised Learning & Clustering:** Criterion functions for clustering, Clustering Techniques: Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.	26

References:

- Richard O. Duda, Peter E. Hart and David G. Stork ,"Pattern Classification", 2nd Edition, John Wiley, 2006.
- C. M. Bishop ,"Pattern Recognition and Machine Learning", Springer, 2009.
- S. Theodoridis and K. Koutroumbas ,"Pattern Recognition", 4th Edition, Academic Press, 2009.

Outcome:

After the completion of the course, the student will be able to:

- CO1: Understand a variety of pattern recognition algorithms, along with pointers on which algorithms work best under what conditions, so that students can make sound decisions on what approaches to take when faced with a real world problem.
- CO2: Understanding the various applications Pattern Recognition in real life applications.
- CO3 Formulate PR models based different classifiers.
- CO4: Apply the Statistical Patten Recognition methods for improving classification
- CO5: Identifying the parameter estimation methods for feature extraction.
- CO6: Analyze the non-parameter Techniques for Pattern classification.
- CO7: Design model based on Machine Learning to Pattern Classification.
- CO8: Analyze the use of Unsupervised Learning for pattern clustering.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO7 /PSO1
CO2	PO1, PO3,PO4/PSO2, PSO3
CO3	PO1, PO2, PO4/PSO3, PSO4
CO4	PO1, PO5/PSO2
CO5	PO2, PO3/PSO4
CO6	PO1,PO2/PSO3
CO7	PO1,PO2, PO3/PSO3, PSO4
CO8	PO1, PO7/PSO3

MSE0005: HIGH PERFORMANCE COMPUTING

Objective: *This subject introduces students to the essential tools and techniques of high performance computing. The main objectives are to introduce students to different frameworks of parallel and distributed computing that they can use in their specific areas of interest. The students may learn to program multi-core processors as well as clusters of personal computers using the widely used computer languages.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Contents	Teaching Hours
I	**Overview of Parallel Techniques:** Classification of Instruction Set Architectures, Instruction level, Thread level and Process level. **Pipelining**: Instruction and functional pipelines, Hazards in a pipeline, Branch prediction techniques; Superscalar Techniques. **Memory Hierarchies:** Basic hierarchical memory concepts, Cache design, Virtual memory design &uses, Memory hierarchy performance. **Parallel Programming Concepts:** Abstract Machine Models – RAM& PRAM, various parallel algorithms on them. **Introduction:** Cloud Computing, Computing Platforms and Developments, Virtualization.	26
II	**Cloud Computing Architecture:** Reference Model, Types of Cloud, Concurrent Computing, High Throughput Computing. **Cloud Applications:**Application in Industry, General Cloud Applications, Advanced Topics in Cloud Computing. **Introduction**: Definition of Grid Computing, Grid Architecture Standard for Grid, Data Management in Grid, Grid Scheduling **Grid Security & Middleware:** Trust and Security in Grid, Grid Middle ware, Architectural Overview of Grid Projects. **Grid Computing Methods:** Monte Carlo Method, Partial Differential Equations, Some Grid Tool- Globus, glite.	26

References:

- John L Hennessy & David A, "Patterson-Computer Architecture: A Quantitative Approach", Morgan Kaufmann, 2011.
- Kai Hwang ,"Advanced Computer Architecture", Tata McGraw Hill Edition, 2013.
- Rajkumar Buyya, Christian Vecchiola & S, Thamarai Selvi ' " Mastering Cloud Computing", Tata McGraw Hill Edition, 2013.
- Fredric Magoules, Jie Pan, Kiat-An Tan & Abhinit Kumar , "Introduction to Grid Computing", CRC Press, Taylor & Francis Group, 2007.

Outcomes:

At the end of this course the students will be able to:

- CO1:Understand architecture of computing technology.
- CO2: Design, formulate and implement high performance versions single threaded algorithms
- CO3: Demonstrate the architectural features of High performance computers
- CO4: Design programs to extract maximum performance in a multicore, shared memory execution environment processor.
- CO5: Design and deploy large scale parallel programs on tightly coupled parallel systems using the message passing paradigm.
- CO6: Administration, scheduling, code portability and data management in an HPC environment.
- CO7: Analyze the suitability of different HPC solutions to problems found in Computational Science.
- CO8: Implement parallel programs on different hardware architectures and software environments.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2/ PSO1
CO2	PO1,PO3,PO4/ PSO2
CO3	PO1,PO2,PO4/ PSO1
CO4	PO1,PO4,PO5,PO6/ PSO2,PSO4
CO5	PO1,PO3,PO5/ PSO2
CO6	PO1,PO2,PO5/ PSO1
CO7	PO1,PO4,PO6/ PSO1,PSO4
CO8	PO2,PO3,PO4/ PSO1,PSO2

MCSE0006: WEB MINING

Objective: *Introduce students to the basic concepts and techniques Web Mining for extracting knowledge from the web.*

Credits: 04 **Semester III** **L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basic Concepts of Web Mining, Classification of Web Mining: Web Content Mining, Web Structure Mining, Web Usage Mining, Issues in Web Mining, Crawling the Web, Hyperlink Analysis, Basics of HTML, HTTP, HTTPS and scripting. **Web Content Mining:** document indexing and retrieval in the web environment, web documents categorization and clustering, Text and Web Page Pre-Processing. **Web Structure Mining:** Anchor Text, Hyperlink Analysis, Static and Dynamic Hyperlinks, Web Graph, Web Search, Query Expansion, Primary web browsing (crawling), Link topology analysis.	26
II	**Social Network Analysis:** Social Sciences and Bibliometry, Prestige, Centrality, Co- citation, PageRank and HITS, Stochastic HITS and Other Variants, Enhanced Models and Techniques, Avoiding Two- Party Nepotism, Outlier Elimination, Exploiting Anchor Text. **Evaluation of Topic Distillation**: HITS Algorithm. **Web Usage Mining Process and Techniques:** Data collection and Pre Processing, Data modeling for web usage mining, Discovery and analysis of web usage patterns, Session and visitor analysis, Cluster analysis and visitor segmentation. **Resource Discovery:** Collecting important pages preferentially, crawling as guided search in a graph, Keyword-Based graph search, Similarity search using Link Topology. **The Future Of Web Mining:** Natural Language Processing, Lexical Networks and Ontologies, Part- of- Speech and Sense Tagging, Parsing and Knowledge Representation, Profiles, Personalization, Collaboration, Opinion mining.	26

References:

- Soumen Chakrabarti, "Mining the Web: discovering knowledge from hypertext data, Part 2", Morgan Kaufmann Publisher, 2010.
- Bing Liu ,"Web Data Mining: exploring hyperlinks, contents, and usage data", Springer, 2007.
- Gordon Linoff and Michael Berry ,"Mining the Web: Transforming Customer Data into Customer Value", John Wiley & Sons , 2002.
- C. Manning, P. Raghavan, and H. Schütze ,"Introduction to Information Retrieval", Cambridge University Press, 2008.
- Ricardo Baeza-Yate, Berthier Ribeiro-Neto, ,"Modern Information Retrieval", Second Edition, Addison Wesly, 2011.

Outcomes:

At the end of this course the students will be able to:

- CO1: Understand the fundamentals of Web Mining Principles for effective web information retrieval
- CO2: Understand the functionality of the various web mining components for knowledge discovery.
- CO3: Compare and evaluate different web mining techniques for structured, unstructured and semi structured data.

- CO4:Extract knowledge using web mining techniques for computing rank of the retrieved results.
- CO5:Acquire statistical techniques to analyze complex information from the content, structure and usages of the web application.
- CO6:Acquire statistical techniques to analyze complex information and social networks;
- CO7:Learn to critically read and connect a significant amount of scientific literature;Apply technical and analytic skills to develop a significant research project.
- CO8:Describe key concepts such as deep web, surface web, semantic web, web log, hypertext, social network, and evaluation measures such as precision and recall.
- CO9: Analyze and explain what web mining problems are satisfiably solved, what is worked upon at the research frontier and what still lies beyond the current state-of-the-art.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2 ,PO4/ PSO3
CO2	PO1,PO2,PO6/PSO4
CO3	PO2,PO3/PSO4
CO4	PO1,PO3/PS1,PS2
CO5	PO1, PO2/PS2,PS3
CO6	PO1,PO2,PO3/PS2,PS3
CO7	PO1,PO3/PS1,PS3
CO8	PO2,PO3/PS1,PS2,PS3
CO9	PO1,PO2,PO3/PSO2,PSO4

MCSE0007: MACHINE LEARNING

Objective: *Introduce students to the basic concepts and techniques Web Mining for extracting knowledge from the web.*

Credits: 04 **Semester III** **L–T–P : 4–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Definition, Applications, Types of learning system **Inductive Classification**: Concept learning, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, finding maximally specific hypotheses, Find-S algorithm, Version spaces and the candidate elimination algorithm, inductive bias. **Evaluation of Learning Algorithms:** Measuring the accuracy of learned hypotheses, cross-validation, learning curves, **Supervised learning:** Linear Regression, Gradient Descent (GD), Classification-Logistic regression, k-nearest neighbor classifier **Decision Tree Learning:** Picking the best splitting attribute: entropy and information gain,ID3 Algorithm, Searching for simple trees and computational complexity, Overfitting, Decision tree classifier,	26
II	**Supervised Learning:** Feature Selection, Feature Extraction, Collaborative Filtering, Support vector machine classifier, Naïve Bayes classifier **Unsupervised Learning:** k-means clustering, Hierarchical clustering **Ensemble Methods:** Bagging, Boosting, Improving classification with Ada-Boost algorithm. **Deep Learning/ Artificial Neural Network:** Introduction, Model Representation, Gradient Descent, Stochastic Gradient Descent, Multilayer Perceptron, Multiclass Representation, Backpropagation Algorithm.	26

Text Book:

- Tom M. Mitchell , "Machine Learning. Tata McGraw-Hill Education, 2013.
- Alpaydin, E. ' "Introduction to machine learning. MIT press, 2009.

Reference Books:

- Harrington, P. ' "Machine learning in action. Shelter Island, NY: Manning Publications Co, 2012.
- Bishop, C. M. ' "Pattern recognition and machine learning (information science and statistics) springer-verlag new york. Inc. Secaucus, NJ, USA, 2006.

Outcome: After completion of Lab, student will be able to:

- CO1: Apply the basic concepts of machine learning.
- CO2: Formulate models based on regression.
- CO3: Design models based on supervise and re-enforcement learning for classification.
- CO4: Apply the ensemble methods for improving classification.
- CO5: Identify the ways of feature extraction, reduction and selection.
- CO6: Analyze the use of machine learning algorithms.
- CO7: Analyze and formulate a model based on CNN.
- CO8: Design application based on machine learning.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs/ PSOs**
CO1	PO1,PO2 / PSO3
CO2	PO2 / PSO3
CO3	PO1, PO3/PSO3
CO4	PO1, PO2/ PSO1, PSO3
CO5	PO2/ PSO3
CO6	PO2/ PSO1 , PSO3
CO7	PO2, PO3/ PSO1, PSO3
CO8	PO3/PSO4