AICTE MODEL CURRICULUM

FOR

POST GRADUATE DEGREE COURSE

M.TECH

IN

COMPUTER SCIENCE AND TECHNOLOGY

WITH SPECIALIZATION IN

ARTIFICIAL INTELLIGENCE & ROBOTICS

[W.E.F. 2019-20]

DEPARTMENT OF

COMPUTER SCIENCE AND SYSTEMS ENGINEERING

AU COLLEGE OF ENGINEERING (AUTONOMOUS)

ANDHRA UNIVERSITY

VISAKHAPATNAM-530 003

ANDHRA UNIVERSITY: VISAKHAPATNAM

M.Tech Computer Science &Technology
Specialization in Artificial Intelligence & Robotics
Course Structure and Scheme of Valuation w.e.f. 2019-20

I SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTCST11	Mathematical Foundations of Computer Science	3	-	70	30	100	3
MTCST12	Advanced Data Structures	3	-	70	30	100	3
MTCSTAIR13	Elective-I	3	-	70	30	100	3
MTCSTAIR14	Elective-II	3	-	70	30	100	3
MTCST15	Research Methodology &IPR	3	-	70	30	100	2
MTCST16	Organizational Behavior (Audit Course)	3	-	70	30	100	0
MTCST17	Advanced Data Structures Lab-		3	50	50	100	2
MTCSTAIR18	Artificial Intelligence Lab		3	50	50	100	2
	Total	**18**	**6**	**520**	**280**	**800**	**18**

Elective-I: Introduction to Robotics/ Distributed Operating Systems/ Computer Organization & Architecture

Elective II: Artificial Intelligence/ Embedded Systems/ Human Computer Interaction

II SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTCSTAIR21	Machine Learning	3	-	70	30	100	3
MTCSTAIR22	Advanced Robotics	3	-	70	30	100	3
MTCSTAIR23	Elective-III	3	-	70	30	100	3
MTCSTAIR24	Elective-IV	3	-	70	30	100	3
MTCST25	Entrepreneurship (Audit Course)	3	-	70	30	100	0
MTCSTAIR26	Machine Learning Lab	-	3	50	50	100	2
MTCSTAIR27	Robotics Lab	-	3	50	50	100	2
MTCSTAIR28	Mini Project With Seminar	-	3	-	100	100	2
	Total	**15**	**9**	**450**	**350**	**800**	**18**

Elective III: Image Processing / Expert Systems/ Computer Vision

Elective IV: Pattern Recognition/ Soft Computing/ Cryptography& Network Security.

III SEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTCSTAIR31	Elective-V	3	-	70	30	100	3
MTCSTAIR32	Open Elective	3	-	70	30	100	3
MTCSTAIR33	Dissertation-I / Industrial project		-	100	-	100	10
Total		**6**	**-**	**240**	**60**	**300**	**16**

Elective V : Sensor Networks/Natural Language Processing/Deep Learning
Open Elective : Business Analytics/Operations Research/Cost Management of Engineering Projects

IVSEMESTER

Code	Name of the subject	Periods/week		Max. Marks		Total	Credits
		Theory	Lab	Ext.	Int.		
MTCSTAIR41	Dissertation - II	-	-	100	-	100	16
Total		**-**	**-**	**100**	**-**	**100**	**16**

FIRST SEMESTER
DETAILED SYLLABUS FOR M.TECH (CST Spl. AI&R)

MTCST11 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE
Common for M. Tech (CST, IT, AI&R, CN, CS&DA)

Instruction: 3 Periods/week	**Time: 3 Hours**	**Credits: 3**
Internal: 30Marks	**External: 70 Marks**	**Total: 100 Marks**

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1. Mathematical notions of sets, sequences and tuples, functions and relations, Primitive recursive functions, computable functions, examples, graphs, strings and languages,

2. Boolean logic – properties and representation, theorems and types of proofs, deductive, inductive, by construction, contradiction and counter-examples.

3. Introduction to Number theory, Divisibility, modular arithmetic (addition modulo and multiplication modulo); Statements and applications of Euler and Fermat Theorems, Primitive Roots, Discrete Logarithms, Primality Test, Finding Large primes, Definition of Elliptic Curves and their applications to Cryptography.

4. Introduction To Finite Automata: Alphabets and languages- Deterministic Finite Automata – Non- deterministic Finite Automata – Equivalence of Deterministic and Non-Finite Automata – Languages Accepted by Finite Automata – Finite Automata and Regular Expressions – Properties of Regular sets &Regular Languages and their applications.

5. Context Free Languages: Context –Free Grammar – Regular Languages and Context-Free Grammar – Pushdown Automata – Pushdown Automata and Context-Free Grammar – Properties of Context-Free Languages – pushdown automata and Equivalence with Context Free Grammars.

6. Turing Machines: The Definition of Turing Machine – Computing with Turing Machines – Combining Turing Machines, programming techniques for Turing Machines,

7. Variants of Turing Machines, Restricted Turing Machines Universal Turing Machines. The Halting Problem, Decidable & un decidable problems- Post Correspondence Problems

Text books:

1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman , Pearson EducationAsia.
2. Cryptography and Network Security, William Stallings.(Second Edition)Pearson EducationAsia.

Reference books:

1. Introduction to languages and theory of computation – John C. Martin(MGH)
2. Discrete Mathematical structures with application to Computer Science – J.P. Tremblay and R.Manohar
3. Introduction to Theory of Computation – Michael Sipser (ThomsonNrools/Cole)
4. Cryptanalysis of number theoretic Cyphers, Samuel S. WagstaffJr.Champan& Hall/CRC Press2003.
5. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes –Ousley, Keith StrassbergTataMcGraw-Hill.

MTCST12 ADVANCED DATA STRUCTURES

Common for M. Tech (CST, IT, AI&R, CN, CS&DA)

Instruction: 3 Periods/week	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

UNIT- I:Heap Structures Introduction, Min-Max Heaps, Leftist trees, Binomial Heaps, Fibonacci heaps.

UNIT-II:Hashing and Collisions Introduction, Hash Tables, Hash Functions, different Hash Functions:- Division Method, Multiplication Method, Mid-Square Method, Folding Method, Collisions

UNIT- III:Search Structures OBST, AVL trees, Red-Black trees, Splay trees, Multiway Search Trees B-trees., 2-3 trees

UNIT-IV:Digital Search Structures Digital Search trees, Binary tries and Patricia, Multiway Tries, Suffix trees, Standard Tries, Compressed Tries

UNIT- V:Pattern matching Introduction, Brute force, the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, Naïve String ,Harspool, Rabin Karp

Textbooks

1. Fundamentals of data structures in C++ Sahni, Horowitz, Mehatha, Universities Press.
2. Introduction to Algorithms, TH Cormen, PHI

References

1. Design methods and analysis of Algorithms, SK Basu, PHI.
2. Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. 3. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, Universities Press.

MTCSTAIR13 Elective-I
INTRODUCTION TO ROBOTICS

Instruction: 3 Periods/week **Time: 3 Hours** **Credits: 3**
Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

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1. Introduction to Robotics: Classification of Robots, History of Robotics ,Advantages and Disadvantages of Robots, Robot Components, Robot Degrees of Freedom, Robot Joints, Robot Coordinates ,Robot Reference Frames, Programming Modes, Robot Characteristics, Robot Workspace, Robot Languages, RobotApplications

2. Kinematics of Robots: Position Analysis, Robots as Mechanisms, Conventions, Matrix Representation, Homogeneous Transformation Matrices, Representation of Transformations, Inverse of Transformation Matrices, Forward and Inverse Kinematics of Robots, Forward and Inverse Kinematic Equations: Position, Forward and Inverse Kinematic Equations, Forward and Inverse Kinematic Equations: Position and Orientation, Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots, The Inverse Kinematic Solution of Robots, Inverse Kinematic Programming of Robots, Degeneracy and Dexterity, The Fundamental Problem with the Denavit-HartenbergRepresentation

3. Trajectory Planning Introduction, Path versus Trajectory, Joint-Space versus Cartesian-Space Descriptions, Basics of Trajectory Planning, Joint-Space Trajectory Planning, Cartesian-Space Trajectories, Continuous TrajectoryRecording.

4. Robot End Effectors Types, Mechanical Grippers and Other types, Tools as End Effectors, The Robot/End Effector Interface, Considerations in Gripper Selection andDesign

5. Actuators and Drive Systems: Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices, Electric Motors, Microprocessor Control of Electric Motors, Magnetostrictive Actuators, Shape-Memory Type Metals, Electro-active Polymer Actuators (EAP), Speed Reduction, OtherSystems

Text Books:

1. Saeed B. Niku, Introduction to Robotics Analysis, Application, Pearson Education Asia, 2001.

Reference Books:

1. R.K.Mittal and I J Nagrath, Robotics and Control, TMH,2003.

2. Computational Intelligence, Davis Poole, Alan Mackwath, Randy Coehel, Oxford University Press1998.

MTCSTAIR13 Elective-I
DISTRIBUTED OPERATING SYSTEMS

Instruction: 3 Periods/week	**Time: 3 Hours**	**Credits: 3**
Internal: 30 Marks	**External: 70 Marks**	**Total: 100 Marks**

Unit-1: Introduction to Distributed Systems, What is a Distributed System?, Hardware concepts, Software concepts, Design issues.

Unit-2: Communication in Distributed Systems, Lay red Protocols, ATM networks, TheClient – sever model, Remote Procedure call, Group communication.

Unit-3- Synchronization in Distributed System, Clock Synchronization, MutualExclusion, Election algorithms, Atomic transactions, Deadlocks in DistributedSystems.

Unit-4-Process and processors in Distributed System threads, System Models,Processors allocation, Scheduling in Distributed System, Fault tolerance, Realtime Distributed System.

Unit-5-Distributed File Systems, Distributed File System Design, DistributedFile System implementation, Trends in Distributed File System.

Unit-6: Distributed Shared Memory, Introduction, What is Shared memory?,Consistency models, Page based Distributed Shared memory, Shared – variableDistributed Shared memory, Object based Distributed Shared Memory.

TEXT BOOK:
Distributed Operating Systems, Andrew S. Tanenbanm

Reference Book:
Advanced Concepts in Operating Systems, Makes Singhal and NiranjanG.Shivaratna.

MTCSTAIR13 Elective-I
COMPUTER ORGANIZATION & ARCHITECTURE

Instruction: 3 Periods/week **Time: 3 Hours** **Credits: 3**
Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

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1. Register Transfer and Microoperations:
Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit.

2. Basic Computer Organization andDesign:
Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output and Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator Logic.

3. **Micro programmedControl**:
Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.

4. Central ProcessingUnit:
Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC)

5. Input/outputOrganization:
Peripheral Devices, I/O interface, Asynchronous data transfer, Modes of transfer, priority Interrupt, Direct memory access, Input-Output Processor (IOP), Serial Communication.

6. **Memory Organization**:
Memory Hierarchy, Main memory, Auxiliary memory, Associate Memory, Cache Memory, and Virtual memory, Memory Management Hardware.

7. Overview of Computer Architecture:
Evolution of Computer Systems, Parallelism in Uni- processor System, Parallel Computer Structures, Architectural Classification Schemes, Parallel Processing Applications.

Text Book:

a. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd.,Third Edition, Sept. 2008.
b. Computer Architecture and Parallel Processing, Kai Hwang and Faye A. Briggs,McGraw Hill, InternationalEdition1985.

Reference Book:

1. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd.,Eastern Economy Edition, Sixth Edition,2003.
2. "Computer System Architecture", John. P.Hayes.
3. ComputerArchitectureAquantitativeapproach3rdeditionJohnL.Hennessy&David A. Patterson Morgan Kufmann (An Imprint of Elsevier).

MTCSTAIR14Elective-II
ARTIFICIAL INTELLIGENCE

Instruction:3Periods/week	**Time:3Hours**	**Credits:3**
Internal:30Marks	**External:70 Marks**	**Total: 100Marks**

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1. **Introduction:** Artificial Intelligence, AI Problems, AI Techniques, the Level of the Model, Criteria for Success. Defining the Problem as a State Space Search, Problem Characteristics, Production Systems, Search: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate- And- Test, Hill Climbing, Best-First Search, A^* Algorithm, Problem Reduction, AO^* Algorithm, Constraint Satisfaction, Means-EndsAnalysis.

2. **Knowledge Representation:** Procedural Vs Declarative Knowledge, Representations & Approaches to Knowledge Representation, Forward Vs Backward Reasoning, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms; Logic Based Programming- AI Programming languages: Overview of LISP, Search Strategies in LISP, Pattern matching in LISP , An Expert system Shell in LISP, Over view of Prolog, Production System usingProlog

3. **Symbolic Logic:** Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification &Resolution, Representation Using Rules, Natural Deduction; Structured Representations of Knowledge: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs, Scripts, CYC;.

4. **Reasoning under Uncertainty:** Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Model and Temporal Logics; Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic: Crisp Sets ,Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences &FuzzySystems.

5. **Experts Systems:** Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells, Fuzzy Expertsystems.

6. **Machine Learning:** Knowledge and Learning, Learning by Advise, Examples, Learning in problem Solving, Symbol Based Learning, Explanation Based Learning, Version Space, ID3 Decision Based Induction Algorithm, Unsupervised Learning, Reinforcement Learning, Supervised Learning: Perceptron Learning, Back propagation Learning, Competitive Learning, HebbianLearning.

7. **Natural Language Processing:** Role of Knowledge in Language Understanding, Approaches Natural Language Understanding, Steps in The Natural Language Processing, Syntactic Processing and Augmented Transition Nets, Semantic Analysis, NLP Understanding Systems; Planning: Components of a Planning System, Goal Stack Planning, Hierarchical Planning, ReactiveSystems

Text Book:

1. Artificial Intelligence, George F Luger, Pearson EducationPublications

2. Artificial Intelligence, Elaine Rich and Knight, Mcgraw-HillPublications

References:

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI

2. Multi Agent systems- a modern approach to Distributed Artificial intelligence, Weiss.G, MITPress.
3. Artificial Intelligence : A modern Approach, Russell and Norvig, PrinticeHall

MTCSTAIR14 Elective-II
EMBEDDEDSYSTEMS

Instruction:3Periods/week **Time:3Hours** **Credits:3**
Internal:30Marks **External:70Marks** **Total: 100Marks**

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1. **Examples of Embedded Systems:**Typical Hardware, Memory, Microprocessors Busses, Direct Memory Access, Introduction to 8051 Microcontroller,Architecture-Instruction set, Programming.

2. **Microprocessor Architecture:** Interrupt Basics, The Shared-Data problem, Interrupt Latency.

3. **Round–Robin Architecture:** Round–Robin with Interrupts Architecture, Function-Queue, Scheduling Architecture, Real-Time Operating Systems Architecture, Selection ofArchitecture.

4. **Tasks and Task States:** Tasks and Data, Semaphores and Shared Data, Semaphore Problems, Semaphorevariants.

5. **Message Queues:** Mailboxes, Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in RTOSEnvironment.

6. **RTOS design:** Principles, Encapsulation Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory Space, SavingPower.

7. **Host and Target Machines:** Linker/Locator for Embedded Software, Getting Embedded Software into the TargetSystem.

8. **Testing on your Host Machine:** Instruction Set Simulators, Laboratory Tools used forDebugging.

Text Book:

1. The 8051 Microcontroller Architecture, Programming & Applications, Kenneth J. Ayala, PenramInternational.

2. An Embedded Software Primer, David E. Simon, Pearson Education ,2005.

Reference Book:

EmbeddedSystemsArchitecture,ProgrammingandDesign,RajKamal,TataMcGraw- Hill Education, 2008

MTCSTAIR14 Elective-II
HUMAN COMPUTER INTERACTION

Instruction:3Periods/week **Time:3Hours** **Credits:3**
Internal:30Marks **External:70Marks** **Total: 100Marks**

UNIT I: Introduction: Usability of Interactive Systems- introduction, usability goals and measures, usability motivations, universal usability, goals for our profession Managing Design Processes: Introduction, Organizational design to support usability, Four pillars of design, development methodologies, Ethnographic observation, Participatory design, Scenario Development, Social impact statement for early design review, legal issues, Usability Testing and Laboratories

UNIT II: Menu Selection, Form Fill-In and Dialog Boxes: Introduction, Task- Related Menu Organization, Single menus, Combinations of Multiple Menus, Content Organization, Fast Movement Through Menus, Data entry with Menus: Form Fill-in, dialog Boxes, and alternatives, Audio Menus and menus for Small Displays

UNIT III: Command and Natural Languages: Introduction, Command organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and large

UNIT IV: Quality of Service: Introduction, Models of Response-Time impacts, Expectations and attitudes, User Productivity, Variability in Response Time, Frustrating Experiences Balancing Function and Fashion: Introduction, Error Messages, Nonanthropomorphic Design, Display Design, Web Page Design, Window Design, Color

UNIT V: User Documentation and Online Help: Introduction, Online Vs Paper Documentation, Reading from paper Vs from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online tutorials and animated documentation, Online communities for User Assistance, The Development Process

UNIT VI: Information Search: Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Searching Interfaces Information Visualization: Introduction, Data Type by Task Taxonomy, Challenges for Information Visualization

Text Books:

1. Designing the User Interface, Strategies for Effective Human Computer Interaction, 5ed, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven M Jacobs, Pearson
2. The Essential guide to user interface design,2/e, Wilbert O Galitz, Wiley DreamaTech.

Reference Books:

1. Human Computer, Interaction Dan R.Olsan, Cengage ,2010.
2. Designing the user interface. 4/e, Ben Shneidermann , PEA.

MTCST15 RESEARCH METHODOLOGY AND IPR

Common for M.Tech (CST, IT, AI&R, CN, CS&DA)

Instruction: 3 Periods/week **Time: 3 Hours** **Credits: 2**
Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

Unit 1: Meaning of research problem, Sources of research problem, CriteriaCharacteristics of a good research problem, Errors in selecting a research problem, Scopeand objectives of research problem.Approaches of investigation of solutions for research problem, data collection, analysis,interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysisPlagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, PaperDeveloping a Research Proposal, Format of research proposal, a presentation andassessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process ofPatenting and Development: technological research, innovation, patenting, development.International Scenario: International cooperation on Intellectual Property. Procedure forgrants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developmentsin IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge CaseStudies, IPR and IITs.

References:

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 ndEdition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

MTCST16 Organizational Behavior (Audit Course)

Common for M.Tech (CST, IT, AI&R, CN, CS&DA)

Instruction:3Periods/week	**Time:3Hours**	**Credits:0**
Internal:30Marks	**External:70Marks**	**Total: 100Marks**

UNIT-I: OrganizationalBehavior: Concept of Organization - Concept of OrganizationalBehavior - Nature of OrganizationalBehavior - Role of Organizationalbehavior - Disciplines contributing to OrganizationalBehavior.

UNIT-II: Motivation: Definition - Nature of Motivation - Role of Motivation - Theories of Motivation: Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and McGregor's Theory X and Theory Y.

UNIT –III: Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

UNIT-IV: Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

UNIT-V: Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication: Downward, Upward and Horizontal communication.

UNIT-VI: Organizational conflicts: Concept of conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intragroup conflict, Intergroup conflict, Interorganizational conflict - Conflict management.

UNIT –VII: Organizational Change: Nature - Factors inOrganizational change -Planned change: Process of planned change - Resistance to change: Factors in resistance to change - Overcoming resistance to change.

Text Books.

1.L.M.Prasad: OrganizationalBehavior, Sultan Chand & Sons, New Delhi -110002
2.K. Aswathappa: OrganizationalBehavior, Himalaya Publishing House, New Delhi

Reference Books.

1. Stephen Robbins: OrganizationalBehavior, Pearsons Education, New Delhi.

MTCST17 ADVANCED DATA STRUCTURESLAB

Common for M.Tech (CST, IT, AI&R, CN, CS&DA)

Instruction: 3Periods/week	**Time: 3Hours**	**Credits: 2**
Internal: 50Marks	**External: 50 Marks**	**Total: 100Marks**

1. Write Java programs that use both recursive and non-recursive functions forimplementing the following searching methods:

a) Linear search b) Binary search

2. Write Java programs to implement the following using arrays and linked lists

a) List ADT

3. Write Java programs to implement the following using an array.

a) Stack ADT b) Queue ADT

4. Write a Java program that reads an infix expression and converts the expression to postfix form. (Use stack ADT).

5. Write a Java program to implement circular queue ADT using an array.

6. Write a Java program that uses both a stack and a queue to test whether the given string is a palindrome or not.

7. Write Java programs to implement the following using a singly linked list.

a) Stack ADT b) Queue ADT

8. Write Java programs to implement the deque (double ended queue) ADT using

a) Array b) Singly linked list c) Doubly linked list.

9. Write a Java program to implement priority queue ADT.

10. Write a Java program to perform the following operations:

a) Construct a binary search tree of elements.

b) Search for a key element in the above binary search tree.

c) Delete an element from the above binary search tree.

11. Write a Java program to implement all the functions of a dictionary (ADT) using Hashing.

12. Write a Java program to implement Dijkstra's algorithm for Single source shortest path problem.

13. Write Java programs that use recursive and non-recursive functions to traverse the given binary tree in

a) Preorder b) Inorderc) Postorder.

14. Write Java programs for the implementation of bfs and dfs for a given graph.

15. Write Java programs for implementing the following sorting methods:

a) Bubble sort b) Merge sort c) Binary tree sort

d) Insertion sort e) Heap sort f) Quick sort g) Radix sort

16. Write a Java program to perform the following operations:

a) Insertion into a B-tree b) Searching in a B-tree

17. Write a Java program that implements Kruskal's algorithm to generate minimum costspanning tree.

18. Write a Java program that implements KMP algorithm for pattern matching.

REFERENCE BOOKS:

1. Data Structures and Algorithms in java, 3rd edition, A.Drozdek, Cengage Learning.

2. Data Structures with Java, J.R.Hubbard, 2nd edition, Schaum's Outlines, TMH.

3. Data Structures and algorithms in Java, 2nd Edition, R.Lafore, Pearson Education.

4. Data Structures using Java, D.S.Malik and P.S. Nair, Cengage Learning.

5. Data structures, Algorithms and Applications in java, 2nd Edition, S.Sahani, UniversitiesPress.

6. Design and Analysis of Algorithms, P.H.Dave and H.B.Dave, Pearson education.

7. Data Structures and java collections frame work, W.J.Collins, McGraw Hill.

8 Java: the complete reference, 7th All editon, Herbert Schildt, TMH

9. Java for Programmers, P.J.Deitel and H.M.Deitel, Pearson education / Java: How toProgram P.J.Deitel and H.M.Deitel , 8th edition, PHI.

MTCSTAIR18 ARTIFICIAL INTELLIGENCE LAB

Instruction:3Periods/week **Time:3Hours** **Credits:2**

Internal:50Marks **External:50 Marks** **Total: 100Marks**

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1. Implementation of DFS for water jug problem using LISP/PROLOG
2. Implementation of BFS for tic-tac-toe problem using LISP/PROLOG/Java
3. Implementation of TSP using heuristic approach usingJava/LISP/Prolog
4. Implementation of Simulated Annealing Algorithm using LISP/PROLOG
5. Implementation of Hill-climbing to solve 8- PuzzleProblem
6. Implementation of Towers of Honoi Problem using LISP/PROLOG
7. Implementation of A* Algorithm using LISP/PROLOG
8. Implementation of Hill Climbing Algorithm using LISP/PROLOG
9. Implementation Expert System with forward chaining using JESS/CLIPS
10. Implementation Expert System with backward chaining usingRVD/PROLOG

Detailed Syllabus for M.Tech(CST spl. AI&R) Second Semester

MTCSTAIR21 MACHINE LEARNING

Instruction:3Periods/week **Time:3Hours** **Credits: 3**
Internal:30Marks **External:70Marks** **Total: 100Marks**

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1. **Introduction:** Introduction to Machine Learning, learning task- illustration, Approaches to Machine Learning, Machine Learning algorithms- Theory, Experiment in biology and Psychology.

2. **Concept Learning:** Introduction, Concept Learning Task- Notation, Concept Learning Search, Version spaces, Candidate Elimination Algorithm, Inductive Bias, Biased hypothesis Space, Unbiased Learner, Bias-free Learning, Active queries, Mistake bound/PAC model – basic results. Overview of issues regarding data sources, successcriteria

3. **Decision Tree Learning:** Decision Tree Representation, Basic decision Tree Learning, Inductive bias in Decision tree Learning, Issues in Decision Tree Learning, Minimum Description Length Principle, Occam's razor, Learning with activequeries

4. **Neural Network Learning:** Neural Network Representation, Problems for Neural Network Learning, Perceptions and gradient descent, Multi Layer Network and Back propagation Algorithm, Illustrative Example of Back Propagation Algorithm- Face Recognition, Advanced Topics inANN.

5. **Bayesian Approaches:** Basics of Bayes Theorem and Concept Learning, Expectation Maximization, Minimum Description Length Principle, Navie Bayes Classifier, Bayesian Belief Networks, EM Algorithm, K-Means Algorithm, Hidden Markov Models Instance-Based Techniques; Lazy vs. eager generalization, k nearest neighbor, Locally Weight Representation, Case-basedReasoning

6. **Analytical Learning:** Inductive and Analytical Learning problems, Learning with perfect Domain Theory, Explanation Based Learning, Inductive Bias in EBL, Search Control Knowledge with EBL, Inductive- Analytical Approaches to Learning, Using prior Knowledge for Initialize the Hypothesis, and Altering Search objective, FOCLAlgorithm.

7. **Genetic Algorithms:** Representation of Hypothesis as GA,, Genetic Operators, Fitness function and Selection, Hypothesis Space search, Genetic Programming, Models of Evolution and Learning, Parallelizing GA, Different search methods forinduction

Text Books:

1.Machine Learning, Tom Mitchell , McGraw Hill,1997
2.The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani& Jerome Friedman, Springer Verlag, 2001

Reference Books:

3.Pattern Classification, Richard 0. Duda, Peter E. Hart and David G. Stork, John Wiley & Sons Inc.,2001
4.Neural Networks for Pattern Recognition, Chris Bishop, Oxford University Press,1995

MTCSTAIR22 ADVANCED ROBOTICS

Instruction:3Periods/week **Time:3Hours** **Credits: 3**
Internal:30Marks **External:70 Marks** **Total: 100Marks**

1.CONTROL SYSTEMS ANDCOMPONENTS:

Basic Control Systems Concepts and Models, Controllers, Control System Analysis, Robot Activation and Feedback Components, Power Transmission Systems, Robot Joint Control Design.

2.SENSORS:

Sensor Characteristics, Sensor Utilization, Position Sensors, Velocity Sensors, Acceleration Sensors, Force and Pressure Sensors, Torque Sensors, Microswitches, Visible Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors, Range Finders, Sniff Sensors, Taste Sensors,

3.IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS:

Basic Concepts, Fourier Transform and Frequency Content of a Signal, Frequency Content of an Image; Noise, Edges , Resolution and Quantization, Sampling Theorem, Image-Processing Techniques, Histogram of Images, Thresholding, Spatial Domain Operations: Convolution Mask, Connectivity, Noise Reduction, Edge Detection, Sharpening an Image, Hough Transform, Segmentation, Segmentation by, Region Growing and Region Splitting, Binary Morphology Operations, Gray Morphology Operations, Erosion, Dilation, Object Recognition by Features, Depth Measurement with Vision Systems, Scene Analysis versusMapping

4.ROBOTPROGRAMMING

Programming methods, Robot program as path in space,Motion Interpolation, WAIT, SIGNAL DELAY Commands, Branching.

5.ROBOTLANGUAGES

The Textual Robot languages, Generations of Robot programming languages, Robot language Structures, Constants, Variables, and other data Objects, Motion Commands, program Control and Subroutines

6.ROBOT APPLICATIONS IN MANUFCATURING:

Material Transfer And Machine Loading/ Unloading, An Approach for ImplementingRobotics

7.FUTURE APPLICATIONS:

Characteristics of Future Robot Tasks, Future manufacturing Applications, Hazardous and Inaccessible NonmanufacturingEnvironments

TEXT BOOK:

1. Mikell P. Groover , Mitchell Weiss , Roger N. Nagel , Nicholas G. Odrey Industrial Robotics: Technology, Programming, and Applications , 1st edition, McGraw-Hill International Edition, 1986
2.Saeed B. Niku, Introduction to Robotics Analysis, Application, Pearson Education Asia,2001.

REFERENCE BOOK: K.S.Fu, R.C Gonzalez, C.S.G.Lee , ROBOTICS , Control, Sensing , Vision and Intelligence , 1st edition, McGraw-Hill International Edition, 1987

MTCSTAIR23 Elective-III
IMAGE PROCESSING

Instruction:3Periods/week **Time:3Hours** **Credits: 3**
Internal:30Marks **External:70 Marks** **Total: 100Marks**

1.Fundamentals of Image Processing: Image Acquisition, Image Model, Sampling, Quantization, Relationship between Pixels, Distance Measures, Connectivity, Image Geometry, Photographic Film. Histogram: Definition, Decision Of Contrast Basing On Histogram, Operations Basing on Histograms Like Image Stretching, Image Sliding, Image Classification. Definition and Algorithm of HistogramEqualization.

2.ImageTransforms : A Detail Discussion On Fourier Transform, DFT,FFT, Properties WALSH TransForm , WFT, HADAMARD Transform,DCT

3.ImageEnhancement:

a) Arithmetic and Logical Operations, Pixel or Point Operations, SizeOperations,
b) Smoothing Filters-Mean, Median, Mode Filters – ComparativeStudy
c) Edge Enhancement Filters – Directorial Filters, Sobel, Laplacian, Robert, KIRSCH Homogeneity
d) DIFF Filters, Prewitt Filter, Contrast Based Edge Enhancement Techniques– Comparative Study
e) Low Pass Filters, High Pass Filters, Sharpening Filters. – ComparativeStudy
f) Colour Fundamentals and ColourModels
g) ColourImage Processing.

4.Image Enhancement: Design of Low Pass, High Pass, EDGE Enhancement, Smoothening Filters in Frequency Domain. Butter Worth Filter, HomomorphicFilters in Frequency Domain Advantages of Filters in Frequency Domain, Comparative Study of Filters in Frequency, DomainandSpatialDomain.

5.Image Compression: Run Length Encoding, Contour Coding, Huffman Code, Compression Due to Change in Domain, Compression Due to Quantization Compression at the Time of Image Transmission. Brief Discussion on:-Image CompressionStandards.

6.Image Segmentation: Characteristics of Segmentation, Detection of Discontinuities, Thresholding Pixel Based Segmentation Method. Region Based Segmentation Methods, Segmentation by Pixel Aggregation, Segmentation by Sub Region Aggregation, Histogram Based Segmentation, Spilt and Merge Technique, Motion inSegmentation

7.Morphology: Dilation, Erosion, Opening, Closing, Hit-And-Miss Transform, Boundary Extraction, Region Filling, Connected Components, Thinning, Thickening, Skeletons , PruningExtensionstoGray– Scale Images Application of Morphology in I.P

8.Image , Video & Multimedia Communications: Multi-scale and multi-orientation representation; Geometry and texture representation; Object based representation; Hierarchical representation; Sparse representation,Multimedia with image and video content; Multimedia event synchronization;

Text Book:

1. Digital Image Processing, Rafael C. Gonzalez And Richard E. Woods, Addision Wesley

ReferenceBooks:

2. Fundamentals Of Electronic Image Processing By Arthyr– R – Weeks,Jr.(PHI)
3. Image Processing, Analysis, And Machine Vision By Milan SonkaVaclanHalavacRogerBoyle, VikasPublishingHouse.
4. Digital Image Processing, S. Jayaraman, S. Esakkirajan& T. VeeraKumar,TMH

MTCSTAIR23 Elective-III
EXPERT SYSTEMS

Instruction:3Periods/week **Time:3Hours** **Credits: 3**
Internal:30Marks **External:70 Marks** **Total: 100Marks**

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1. **Introduction:** Introduction to Expert System, Definitions, Importance of Expert System, Charactestic features of Expert System, Applications of Expert System, Different ategories of Expert Systems, Rule Based System Archicture, Nural Network Archicture
2. **Knowledge Represention:** Components of a Knowledge in Expert system**,**OAV Triplets, Sementic Networks, FramsRepresention via Logic Statements, Production Systems, Clause, Properties Rule properties, Rule Conversions, Multiple Conclusions,Nural Networks via Rule Based System
3. **Knowledge Acqusition:**Introduction Knowledge Acqusition and domain Expert, Selection of the domain, Selection of the Knowledge Engineers, Selection of the Expert, Meetings and Plans, Orgnization of Meetings,Documentation, Multiple domain Experts, Knowledge Acqisition -An Example, Knowledge Acquisition using Rule induction, Generating Rules from Trees, ID3 algorithm for RuleGeneration
4. **Design of Expert System:**Introduction,Selecting the appropriate Probblem,Stateges in the Developing Expert System, Errors in Development stages, Software Engineering and Expert Systems,The Expert System Life Cycle, Expert System Design Examples- Certainty factors,Decission tress
5. **Inference Engine:** Inference Engine, Insight of Inference Engine, Search Strategies, Forward Chaining Algorithm,Algorithms for forward Chaining- Baseline Version, Backword Chaining Algorithm, Algorithms for Back word Chaining-Baseline Version, Mixed Modes of Chaining, Work sheets for Forward and Back wordChaining
6. **Reasoning Under Uncertainity:** Uncertainty,Types of Error,Error and Induction,ClassicProbabulity,TemporalReasioning and MorcovChines,TMS,Fuzzy Logic and Natural Languages computations,ProbabilisticReasioning, probabilistic Networks,BayesianNetworks.Use of Probabilty and Fuzzy logic in Expert System, Rule Induction by MachineLearning
7. **Software Tools and Architectures:** Overview of Expert System Tools, Expert System Shells,Multiple Paradigm Environments,Absract architectures, Potential Implementation Problems, Selecting a Software Tool, Implentation Mechanism of tools, Black Board Architecture, Reasoning under uncertainityandTruthMaintanceSystems

Case-study :A case-study on Financial planning Expert System, Sale Expert system, DENDRAL andMYCIN

Text Books:

1. Expert System principals and Programming-Giarratano.Rilev.2003
2. Introducion to Expert SystemsV-JamesP.Iginizo.Mc.Graw-Hill.inc
3. Introduction to Expert Systems Peter Jackson, Addison Wesley PublishingCompany

References:

1. Introduction to artificial Intelligence & Expert System- PanW.patterson.PHI
2. A Comprehensive Guide to AI and Expert systems, R.I.Levine D.E. Drang, BarryEdelson

MTCSTAIR23 Elective-III
COMPUTER VISION

Instruction:3Periods/week **Time:3Hours** **Credits:3**
Internal:30Marks **External:70Marks** **Total: 100Marks**

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1. **FUNDAMENTALS OF IMAGE PROCESSING:** Image Acquisition, Definitions of Pixel, Gray Value, Sampling, Quantization, Histogram, Image Sliding, Image Stretching. Distance and Connectivity. Image Smoothening Operations - Mean, Median, Mode Filters. Edge Enhancement Filters - Directional Filters, Laplacian, Sobel, and Robert. Definition of Image Compression - Run Length Encoding Method, Contour Encoding Method. Definition of Segmentation - Pixel based method ofsegmentation.

2. **MORPHOLOGICAL OPERAT IONS:** Definition of Thresholding, A few techniques of thresholding. Importance of Binary Images. Erosion, Dilation, Opening, Closing, HIT -or -MISS Transformation, Thinning, Thickening, Skeletons, Pruning, Con vex hull. Extensions to Gray - Scale Images.Applications of Gray - Scale Morphology. Applications of Morphological Operations in PatternAnalysis.

3. **SHAPE REPRESENTATION AND DESCRIPTIONS (Part - 1):** Region Identification, Algorithms for Region Identification, Shape Representation and Description - Chain Codes, Geometric Border Representation - Boundary Length, Curvature, Bending Energy, Signature, Chord Distribution, Fourier Transforms of Boundaries, Boundary Description using Segment Sequences, B -Spline Representation, Shapeinvariants.

4. **SHAPE REPRESENTATION AND DESCRIPTION (Part - 2):** Region - Based Methods - Area - Algorithms for Calculation of Area. Euler‟s Number, Projections, Eccentricity, Elongatedness, Rectangularity, Direction, Compactness. Detailed Discussion on - Moments. Convex hull, Algorithms related to convex hull. Graph Representation - Algorithm for Skeleton, Algorithm for Graph Construction. Definitions of Region Decomposition, Region Neighborhood Graphs, ShapeClasses.

5. **OBJECT RECOGNITION:** Knowledge Representation, Statistical Pattern Recognition, - ClassificationPrinciples,ClassifierSetting,andClassifierLearning.SyntacticPatternRecognition
Grammars, and Languages, Syntactic Analysis, Syntactic Classifier.Recognitionas Graph Matching - Isomorphism, Related Algorithms. Similarity ofGraphs.

6. **CLUSTER ANALYSIS:** Definition, Hierarchical Clustering, - Agglomerative Clustering Algorithms, Single - Linkage Algorithm, Complete Linkage Algorithm, Average - Linkage Algorithm, Ward‟sMethod. Partitional Clustering - Definition, Forgy‟sAlgorithm, K - MeansAlgorithm, Isodata Algorithm. Applications in Pattern Analysis.

7. **ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC IN PATTERN ANALYSIS:** Introduction to ANN, Architecture of ANN, Activation Functions,Training of ANN
Supervised, Unsupervised, Reinforced, McCulloch - Pitts Model, HEBBNET, ADELINE, and Application of ANN in Pattern Analysis. Definition and Brief Discussion about Fuzzy Logic, Fuzzy Sets.Application in PatternAnalysis.

Text Books :

1. Pattern Recognition and Image Analysis, Earl Gose, Richard Johnsonbaugh, Steve Jost ,PHI
2. Image Processing, Analysis and Machine Vision, Milan Sonka, Vaclav Hlavac, VIKAS

References:

Introduction to Artificial Neural Networks, S.N. Sivanandam, M. Paul Raj ,VIKAS

MTCSTAIR24Elective-IV
PatternRecognition

Instruction:3Periods/week	**Time:3Hours**	**Credits: 3**
Internal:30Marks	**External:70Marks**	**Total: 100Marks**

1. **Introduction:** Overview of Pattern Recognition- Relations of PR with other Systems, PR Applications, Different Approaches to Pattern Recognition- Statistical Approach to PR, Syntactic Approach to PR, Neural Approach to PR, Examples of PR Approaches. Other Approaches toPR.

2. **Structure of PR System:** Abstract Representation of PR Mappings, Structure of PR System, Patterns and Feature s, Feature Extraction Examples, Object Description and Classification, Figure Recognition, Numerical Results and Analysis. Feature Vector and Feature Space, training and Learning in PRSystem.

3. **Statistical Pattern Recognition**: Introduction, Gaussian Case and Class Dependency, Discriminate Function, Examples, ClassifierPerformance,

4. **Training**: Parametric Estimation and Supervised Learning, Maximum Likely Hood Estimation, Bayesian Parameter Estimation Approach , Parzen Windows, Direct Classification Using Training set., Unsupervised Learning and Clustering, Clustering for Unsupervised Learning and Classification

5. **Syntactic Pattern Recognition**: Overview of Syntactic Pattern Recognition, Grammar Based Approaches and Applications, Examples of String Generation as Pattern Description, 2-D line Drawing Description Grammar, Character Description using PDL, Object Description using Projected Cylinder Models, Block World Description Models, Heuristic Generation of Grammars,

6. **Recognition of Syntactic Description:** Recognition by Matching, Recognition by Parsing, CYK Parsing Algorithm, Augmented Transition Nets in Parsing, Graph Based structure representation, Structured Strategy to Compare AttributedGraphs.

7. **Neural Pattern Recognition**: Introduction to Neural Networks,, Neural Network Structure for PR Applications, Physical Neural Networks, ANN Model, NN Based PR Association, Matrix Approaches andExamples

8. **Feed Forward Neural Networks** : Training by Back Propagation, Hope field Approach to Neural Computing, Other related Neural Approaches andExtensions

Text Book:

1. Pattern Recognition- Statistical, Structural and Neural Approaches, Rober.J. Shelkoff, John Wiley & Sons, NY1992,ISBN0-471-52974-5

Reference Book:

1. Neural Networks for pattern recognition, Christopher M.Bishop Oxford UniversityPress.
2. Pattern Classification, Richard O.Duda ,Wiley IndiaEdition

MTCSTAIR24 Elective-IV
SOFT COMPUTING

Instruction:3Periods/week **Time: 3Hours** **Credits: 3**
Internal: 30Marks **External:70 Marks** **Total: 100Marks**

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1. Introduction to Intelligent systems and Soft Computing:
   Intelligent Systems, Knowledge based Systems, Knowledge representation and Processing, Soft Computing

2. Fundamentals of Fuzzy logicsystems:
   Evolution of Fuzzy logic, developmental stages and utility in Expert system development, Fuzzy sets, Fuzzy operators, generalized operators, implication, support set and alpha cut, fuzzy resolution, measures of fuzziness fuzzy relations, composition and inference, fuzzy decision making

3. Fuzzy logicControl:
   Basics of fuzzy control, Defuzzification, Fuzzification, fuzzy control surface, Fuzzy control architectures, Properties of fuzzy control, robustness and stability

4. Fundamentals of Artificial Neuralnetworks:
   Learning and acquisition of knowledge, features of ANN, topologies, learning algorithms, Fundamentals of Connectionist Modeling

5. Major classes of Neuralnetworks:
   Multi-layer perceptron, RBF networks, Kohonen's self organising networks, Hopfield networks, Industrial and commercial applications of ANN

6. Dynamic Neural networks and theirApplications:
   Basics concepts, dynamica and architecture of Recurrent networks (RNN), training algorithms, Dynamic neural networks for identification and control, Dynamic neural networks for chaos time series prediction, ANN for chaos prediction

7. Neuro-fuzzySystems:
   Architectures of neuro-fuzzy systems, cooperative neuro-fuzzy systems, Hybrid neuro-fuzzy systems, construction of neuro-fuzzy systems, structure identification and parameter learning phases

8. EvolutionaryComputing:
   Overview of evolutionary computing, Genetic algorithms, and Optimisation, schema theorem, Genetic algorithm operators, Integration of genetic algorithms with neural networks, Integration of GA with fuzzy logic, Population based incremental learning,

Text Book:

1. Soft Computing and Intelligent Systems Design, FakhreddineO.Karray and Clarence De Silva, Pearson Edu

Reference Book:

1. Fuzzy Logic With Engineering Application , Timothy J.Ross, John Wiley & Sons PublishingCompany
2. Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms, Samir Roy, Ist Edition, Pearson Edu

MTCSTAIR 24 Elective IV

Cryptography & Network Security

Instruction:3Periods/week **Time: 3Hours** **Credits: 3**
Internal: 30Marks **External:70 Marks** **Total: 100Marks**

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1 **Overview:** Computer Security Concepts, Threats, Attacks, and Assets, Security Functional Requirements, A Security Architecture for Open Systems, ComputerSecurity Trends, Computer Security Strategy. Cryptographic Tools: Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions,Public-Key Encryption, Digital Signatures and Key Management, Random andPseudorandom Numbers, Practical Application: Encryption of Stored Data. User Authentication:Means of Authentication, Password-Based Authentication, Token-BasedAuthentication, Biometric Authentication, Remote User Authentication, Security Issues forUser Authentication, Practical Application: An Iris Biometric System, Case Study:Security Problems for ATMSystems.

2 **Access Control:** Access Control Principles, Subjects, Objects, and AccessRights, Discretionary Access Control, Example: UNIX File Access Control, Role-BasedAccess Control, Case Study: RBAC System for a Bank. Database Security: The Need forDatabase Security, Database Management Systems, Relational Databases, DatabaseAccess Control, Inference, Statistical Databases, Database Encryption, CloudSecurity.

3 **Malicious Software:** Types of Malicious Software (Malware),Propagation—Infected Content—Viruses, Propagation—Vulnerability Exploit—Worms,Propagation—Social Engineering—SPAM E-mail, Trojans, Payload—System Corruption,Payload—Attack Agent—Zombie, Bots, Payload—Information Theft—Key loggers, Phishing,Spyware, Payload—Stealthing—Backdoors, Root kits,Countermeasures.
Denial-of-Service Attacks: Denial-of-Service Attacks, Flooding Attacks,Distributed Denial-of-Service Attacks, Application-Based Bandwidth Attacks, Reflector andAmplifier Attacks, Defenses Against Denial-of-Service Attacks, Responding to aDenial-of-Service Attack.

4 **Intrusion Detection:** Intruders, Intrusion Detection, Host-Based IntrusionDetection, Distributed Host-Based Intrusion Detection, Network-Based IntrusionDetection, Distributed Adaptive Intrusion Detection, Intrusion Detection ExchangeFormat, Honeypots, Example System: Snort. Firewalls and Intrusion Prevention Systems:The NeedforFirewalls,FirewallCharacteristics,TypesofFirewalls,FirewallBasing,Firewall Location and Configurations, Intrusion Prevention Systems, Example: UnifiedThreatManagementProducts.

5 **Buffer Overflow:** Stack Overflows, Defending Against Buffer Overflows, Other Formsof Overflow Attacks, Software Security: Software Security Issues, Handling ProgramInput, Writing Safe Program Code, Interacting with the Operating System and OtherPrograms,Handling Program Output. Operating System Security: Introduction to OperatingSystem Security, System Security Planning, Operating Systems Hardening, ApplicationSecurity, Security Maintenance, Linux/Unix Security, Windows Security, VirtualizationSecurity.

6 **Symmetric Encryption and Message Confidentiality:** Symmetric EncryptionPrinciples, Data Encryption Standard, Advanced Encryption Standard, Stream Ciphers andRC4, Cipher Block Modes of Operation, Location of Symmetric Encryption Devices,Key Distribution. Public-Key Cryptography and Message Authentication: SecureHash Function, HMAC, The RSA Public-Key Encryption Algorithm, Diffie-Hellman andOtherAsymmetricAlgorithms.

7 **Internet Security Protocols and Standards:** Secure E-mail and S/MIME, DomainKeys IdentifiedMail,SecureSocketLayer(SSL)andTransportLayerSecurity(TLS),HTTPS, IPv4 and IPv6 Security. Internet Authentication Applications: Kerberos, X.509,Public-Key Infrastructure, Federated Identity Management. Wireless Network Security:Wireless Security Overview, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i WirelessLAN Security.

TextBook:

1. Computer Security - Principles and Practices (Except the Chapters 13, 14, 15, 16, 17,18, 19), 2nd Edition by William Stallings, Pearson Education,Inc.

ReferenceBooks:

1. Cryptography and Network Security by William Stallings, Pearson Education Asia,New Delhi.
2. NetworkSecurityEssentialsApplicationsandStandards,byWilliamStallings,Pearson Education Asia, NewDelhi.

MTCST25 ENTREPRENEURSHIP (Audit Course)

Common for M. Tech (CST, IT, AI&R, CN, CS&DA)

Instruction:3 Periods/week **Time: 3 Hours** **Credits: 0**

Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

Unit -I

Basic Concepts of Management:- Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management. **(Eight Periods)**

Unit-II

Forms of Business Organizations: Introduction, Types of Business organizations**: Private Secto**r- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations**; Public sector**- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.**(Eight periods)**

Unit-III

Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance. **(Ten periods)**

Unit-IV

Entrepreneurship : Definition, Characteristics and Skills , Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship. **(Six periods)**

Unit-V

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

(Eight periods)

Text Books:

(1)Sharma,S.C, and Banga, T.R., **Industrial Organization & Engineering Economics**, Khanna Publishers, Delhi, 2000.
(2) VasantDesai ,**The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth),**HImalayan Publishing House, 2018.

Reference Books:

(1) Aryasri , A.R., **Management Science,** McGraw HIll Education (India Private Limited , New Delhi 2014.
(2) Sheela, P. , and JagadeswaraRao, K., **Entrepreneurship**, Shree Publishing House, Guntur,

MTCSTAIR26MACHINE LEARNING Lab

Instruction:3Periods/week	**Time:3Hours**	**Credits: 2**
Internal:50Marks	**External:50marks**	**Total:100Marks**

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1. The programs can be implemented in either JAVA or Python.
2. For Problems 1 to 6 and 10, programs are to be developed without using the built-in classes or APIs of Java/Python.
3. Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

Lab Experiments:

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

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

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

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

5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

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

MTCSTAIR27 ROBOTICS LAB

Instruction:3Periods/week	**Time:3Hours**	**Credits: 2**
Internal:50Marks	**External:50marks**	**Total:100Marks**

This Lab is intended to get familiarized with mechanical, electrical, and electronics structures of different types of robots for monitoring, controlling and developing applications like pick and place, swapping, e.t.c., by either stand alone controller in the robot structure or interfacing toPC.

1. Programming a simple Robot on Wheels.
2. Programming a Walking Robot.
3. Experiments based on Bipedal Robot.
4. Experiments based on Humanoid Robot-ROOBONOVA.
5. Pick and Place Application Programming with 4 DOF Robot Arm by Interfacing to PC.
6. Swap Application Programming with 4 DOF Robot Arm by Interfacing to PC.
7. Pick and Place Application Programming with 5 DOF Robot Arm by Interfacing to PC.
8. Swap Application Programming with 5 DOF Robot Arm by Interfacing to PC.
9. Pick and Place Application Programming with 6 DOF Robot Arm by Interfacing to PC.
10. Swap Application Programming with 6 DOF Robot Arm by Interfacing to PC.

REQUIRED MATERIALS

Mechanical Tools with Tool Box,, IBM Compatible PCs-

10 No,.. Interface Cables for Robot Structures.

Robot Platform.

Walking Robot structure with

Controller.BRAT Kit for Bipedal

Robot.

Simple HumanoidRobot-

ROBONOVA-I.5 DOF Robot

Arm withAccessories.

6 DOF Robot Arm withAccessories.

Detailed Syllabus for M.Tech (CST spl. AI&R) Third Semester
MTCSTAIR31 Elective-V
SENSOR NETWORKS

Instruction:3Periods/week **Time:3Hours** **Credits: 3**
Internal:30Marks **External:70 Marks** **Total: 100Marks**

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1. **Introduction:** The vision of Ambient Intelligence, Application examples, Types of applications, Challenges for Wireless Sensor Networks(WSNs), Sensor networks vs Enabling Technologies for WSNs, **Single node architecture:** Hardware components, Energy consumption of sensor nodes, Some examples of sensor nodes, Operating systems and execution environments

2. **Network architecture:** Sensor network scenarios, Optimization goals and figures of merit, Design principles for WSNs,

3. **Physical layer and transceiver design considerations in WSNs:**
   MAC Protocols: Fundamentals of (wireless) MAC protocols, Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, The IEEE 802.15.4 MAC protocol, How about IEEE 802.11 and Bluetooth

4. **Link layer protocols:** Fundamentals: tasks and requirements, Errorcontrol, Framing, Link management

5. **Naming and addressing:** Fundamentals, Address and name management in wireless sensor networks, Assignment of MAC addresses, Content-based and geographic addressing

6. **Routing protocols:** The many faces of forwarding and routing, Energy-efficient unicast, Broadcast and multicast, Geographic routing.

7. **Data-centric and content-based networking :** Introduction, Data-centric routing, Data aggregation, Data-centric storage

8. **Transport layer and Quality of Service:** The transport layer and QoS in wireless sensor networks, Coverage and deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and ratecontrol

TEXT BOOK:

References

1. Protocols and Architectures for Wireless Sensor Networks, Holger Karl, Andreas Willig., John Wiley & Sons Ltd, 2005

2. Network Management Fundamentals, AlexenderClemn CISCIPress2007

MTCSTAIR31ELECTIVE-V
NATURAL LANGUAGE PROCESSING

Instruction:3Periods/week **Time:3Hours** **Credits: 3**
Internal:30Marks **External:70Marks** **Total: 100 Marks**

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1. **Introduction**: Introduction to Natural Language Processing, Linguistic Background, Phases in Natural Language understanding, Spoken Language input and output Technologies, Written text input, Mathematical Methods, Statistical Modeling and Classification, Finite State Methods,
2. **Grammars for Natural Language Processing**, Parsing, Semantic and Logic Form, Ambiguity Resolution, SemanticInterpretation
3. **Information Retrieval Architecture:** Indexing, Storage, Compression Techniques, Retrieval Approaches,Evaluation,
4. **Search Engines**: Commercial Search Engine features, Comparison, Performance Measures, Document Processing, NLP Based Information Retrieval, InformationExtraction.
5. **Text Mining**: Categorization, Extraction Based Categorization, Clustering, Hierarchical Clustering, Document Clustering andRouting,
6. **Finding and Organizing Answers from Text Search**, Use of Categories and Clusters for Organizing Retrieval Results, Text Categorization and Efficient Summarization Using Lexical Chains, PatternExtraction
7. **Generic Issues:**Multilinguality, Multilingual Information Retrieval and Speech Processing, Multimodality, Text and Images, Modality Integration, Transmission and Storages, Speech coding, Evaluation of Systems, Human Factors andAcceptability
8. **Applications:** Machine Translation, transfer Metaphor, Interlingua and statistical Approaches, Discourse Processing, Dialog and Conversational agents, Natural Language Generation, Surface Realization and DiscoursePlanning

Text Books:

1. Speech and Language processing, Daniel Jurafsky and JamesH Martin,2000, PrinticeHall
2. Foundations of Statistical Natural Language Processing, ChristopherD Manning HinrichSchutze, MITPress,1999

References:

1. Survey of the State of the art in Human Language Technology, Ron Cole, J. Martin, et.al, Cambridge UniversityPress
2. Survey of Text Mining, Clustering, Classifications and Retrieval, Michael W. Berry, Springer Verog,2003
3. Natural language understanding, James Allen, Benjaman/CumingsPublishingCo.
4. InformationStorageandRetrievalsystems,GeraldJKowalskiandMarkTMaybury, Kulwer AcademicPublishers,2000
5. Natural Language Information retrieval, Tomek Strzalkowski, Kulwer Academic Publishers,1999

MTCSAIR31 ELECTIVE-V
DEEP LEARNING

Instruction:3 Periods/week **Time: 3 Hours** **Credits: 3**

Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

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1. Machine Learning Basics: Learning Algorithms, Capacity, Overfitting, and Underfitting, Hyperparameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised and Unsupervised Learning algorithms, Stochastic Gradient Descent, Building a ML algorithm, Challenges and Motivation to Deep learning

2.Deep forward Networks: Learning XOR, Gradient -based Learning, Hidden Units, Architecture Design, Back-propagation and other Differentiation algorithms

3.Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as constrained Optimization, Regularization and under -constrained problems, dataset Augmentation, Noise robustness, semi-supervised learning, multitask learning, Early stopping, parameter tying and setting, sparse presentations, bagging and other ensemble methods, dropout, adversarial training, tangent distance, prop and manifold tangent classifier

4.Optimization for Training Deep Models: Difference between learning and pure optimization, Challenges in NN optimization, Basic algorithms, parameter Initialization strategies, Algorithms with adaptive learning rates, approximate second order methods, Optimization strategies and meta algorithms

5.**Convolutional Networks:** Convolution operation**,** Motivation, pooling, convolution and pooling as an infinitely strong prior, variants of basic convolution function, structured outputs, data types, efficient convolution algorithms, random or unsupervisedfeatures

6. Sequence Modeling: Recurrent and recursive nets: Unfolding computational graphs, recurrent neural networks, bidirectional RNNs, Encoder-decoder Sequece-to-sequence Architectures, Deep recurrent networks, recursive neural networks, challenge of long-term dependencies, echo state networks, leaky units and other strategies for multiple time scales, Long Short -term Memory (LSTM) and other gated RNNs

7. Practical methodology and applications: Performance metrics, default baseline models, determining whether to gather more data, selecting hyperparameters, debugging strategies, multi-digit number recognition, large scale deep learning, applications in computer vision and NLP

Text Book:

1. "Deep Learning", Ian Goodfellow, YoshuaBengio and Aaron Courville, published by MIT Press,UK, 2017 Series
2. Deep Learning with Keras: The Textbook by Antonio Gulli and Sujit Pal, PacktPublishing Ltd, Birmingham, UK, April 2017

Reference Book:

1. Deep Learning with TensorFlow, The Textbook by Giancarlo Zaccone, Md. Rezaul Karim, and Ahmed Menshawy, Packt Publishing Ltd, Birmingham, UK, April 2017.

MTCSAIR32 OPEN ELECTIVE
BUSINESS ANALYTICS

Instruction:3 Periods/week **Time: 3 Hours** **Credits: 3**

Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

Unit I: Business Analytics and Optimization

Introduction to Business Analytics and Optimization, Challenges - Volume, Variety (Diversity),and speed of Data Creation (and needed decisions), Approaches to help maximize profitabilityand returns, Business Analytics Capabilities, Enterprise Analytics Capabilities, BusinessAnalytics Technologies, Predictive Analytics, Prescriptive Analytics, A fact-based decisionmaking culture, A strong data infrastructure, The Right Analytical Tools, Analytics Workforce,Knowledge Requirements, Business Analyst, Data Scientist, Where to put the analytics team,IBM Business Analytics Maturity Model, Optimization, Key BAO Concepts, The need for BAOnow, Essential Capabilities In BAO, BAO Capabilities: Business Performance Management,Predictive Analysis and Mining, Value of BAO to Business Organization, Impact of BAO ondiverse industries, Advantages to implementing BAO solutions, BAO Capabilities: Real-timeAnalytics: Data In Motion, BAO support for decision-making, High level architecture of BAO,Importance of reference architecture, BAO reference architecture, BAO reference architecture toBAO architects, IBM Technology Portfolio for BAO.

Unit II: Data Warehouse

Decision Support, Three-Tier Decision Support Systems, Exploring and Analyzing Data, What isa data warehouse? Data warehouse architecture choices, Enterprise data warehouse, Independentdata mart architecture, Dependent data mart architecture, Data Warehouse, Data warehouseusage, Multidimensional Data, Conceptual Modeling of Data Warehouses, The "Classic" StarSchema, The "Snowflake" Schema, The "Fact Constellation" Schema, Data Warehouse DesignProcess, Single-Layer Architecture, Two-Layer Architecture, Three-Tier Data WarehouseArchitecture, Data Warehouse Development, Multi-Tiered Architecture, Information pyramid,BI reporting tool architectures, Types of BI users, Multidimensional analysis techniques, DataAnalysis and OLAP, OLAP Server Architectures, Data Cube, Discovery-Driven Data Cubes,OLTP vs. OLAP, Business Query, Dashboards and Scorecards Development, Metadata Model,Automated Tasks and Events, Mobile BI, Disconnected BI, Collaborative BI, Real-timeMonitoring, Software Development Kit (SDK), Setting up data for BI, Making BI easy toconsume.

Unit III: Business Intelligence

Definitions of Business Intelligence, Sample BI Architecture, Things are getting more complex,BI Components and Architecture, Scope and fit of BI solutions within existing infrastructure,High Level BI Process, Functional Areas of BI Tool, A single or a few applications, Benefits ofBI, Maximize Value from BI Systems, Strategy and Business Intelligence, BusinessTransformation Projects, Business Role of BI (TWDI), ASUG Business Intelligence MaturityModel, Why Act? BI Effectiveness Scorecard, BI Value Scorecard, Five key areas of strategy,Planning a BI Project, Pre-Engagement Activities, Engagement Activities and process, BIDesign and Development, Business Environment, Project Tasks: Task 1- Knowledge CaptureGoals - Discuss Business Objectives & Prior Learning, Interview key stakeholders, ProjectPlanning, Task 2 - Consolidate Findings - Create logical design, Task 3 - Map the CustomerSituation - Current Environment, Business/Functional

Requirements Sample Diagram, LogicalBI Diagram, Task 4 -Methodology & Approach, Task 5 - Standards & Governance, Task 6 -Sections, Milestones and Tasks, Task 7 – Proof of Concept (POC), Task 8 – Table Creation,Task 9 – OLAP Creation, Task 10 –Final Deliverables, Risk management and mitigation, Costjustification and measuring success.

Unit IV: Data Mining

Data Mining, Evolution of Data Mining, Knowledge-Based System,Data Mining Process, Phases of Data Mining Process, KDD Process Model, CRISP - DM,CRISP-DM - Elaborate view, Data Mining – On what kinds of Data? DM Tasks andComponents of DM methods, Data mining operations, Data mining techniques, Industryexamples of application of DM, Challenges of Data Mining, Why Machine should "Learn"?What is Machine Learning? Growth of Machine Learning, Machine Learning types,Unsupervised learning, Reinforcement Learning.

Unit V: Big Data Analytics

Big Data, Intrinsic Property of Data, A Growing Interconnected andInstrumental World, Need for Big Data, Characteristics of Big Data, Structure of Big Data andneed for standards, Big Data Analytics Adoption, Benefits & Barrier of Big Data Analytics,Trends for Big Data Analytics, Commoditization of Hardware Enabling New Analytics, the 5Key Big Data Use Cases, More Ways – Wide Ranging Analytics and Techniques, Big DataPlatform and Application Frameworks, A Big Data Platform Manifesto, Use Cases for a BigData Platform.

Books:

Introduction to Business Analytics (IBM ICE Publication)

MTCSAIR32 OPEN ELECTIVE
OPERATIONS RESEARCH

Instruction:3 Periods/week **Time: 3 Hours** **Credits: 3**

Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

UNIT I: Overview of Operations Research, Types of OR Models , Phases of Operations Research– OR Techniques, Introduction to Linear Programming, Formulation of Linear Programming Problem, Graphical Solution; Graphical Sensitivity Analysis

UNIT II: Standard Form of LPP, Basic Feasible Solutions , Unrestricted Variables, Simplex Algorithm , Artificial Variables, Big M Me th od , Two Phase Simplex Method, Degeneracy, Alternative Optimal, Unbounded Solutions, Infeasible Solutions, Primal And Dual Problems And Their Relations, Dual Simplex Method

UNIT III: Transportation Problem as LPP, Initial Solutions, North West Corner Rule, Lowest Cost Method, Vogels Approximation Method, Optimum Solutions of TPP, Degeneracy in Transportation, Transportation Algorithms

UNIT IV: Assignment Problem , Assignment Problem as LPP, Hungarian Method, Travelling Salesman Problem, Solutions Of TSP, Sequencing Problems, N-Jobs Two Machine Problems, N-Jobs K Machines Problems, Two-Jobs M- Machine Problems, Crew Scheduling Problems

UNITV: Network Representation of A Project, CPM and PERT , Critical Path Calculations, Time – Cost Optimizations, PERT Analysis and Probability Considerations, Resource Analysis in Network Scheduling.

UNIT VI: Replacement Problems-Individual And Group Replacement Policy, Reliability & System Failure Problems, Inventory-Factors Effecting Inventory-EOQ, Inventory Problems With and Without Shortages, Inventory Problems With Price Breakups, Multi Item Deterministic Problems. Probabilistic Inventory Problems

UNIT VII: Game Theory : Two Person Zero Sum Games , Mixed Strategy Games and Their Algorithms.

TextBooks:

1. Operations Research, KantiSwaroop, P.K. Gupta, Man Mohan, Sulthan Chand&SonsEducation

2. OperationsResearch–AnIntroduction, HandyATaha–PearsonEducation.

MTCSAIR32 OPEN ELECTIVE
COST MANAGEMENT OF ENGINEERING PROJECTS

Instruction:3 Periods/week **Time: 3 Hours** **Credits: 3**

Internal: 30 Marks **External: 70 Marks** **Total: 100 Marks**

Unit 1:

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 2

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit 3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decisionmakingproblems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory
of constraints.

Unit 4

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Charles T. Horngren, Srikant M. Datar, Cost Accounting A Managerial Emphasis, Pearson, 13th Edition, 2009.
2. Ahmed Riahi- Belkaoui., Advanced Management Accounting, Greenwood Publication Group, 2001.
3. Robert S Kaplan Anthony A. Alkinson, Management Accounting, Prentice Hall, 4th Edition, 2003.
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1998.
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd., 2015.

IVSEMESTER

code	Name of the subject	Periods/week/max.marks				
		Theory	Ext	Int	total	Credits
MTCSTAIR41	Dissertation - II -	-	100	-	100	16
	Total		100	-	100	16

1. A publication of a paper on the thesis work in a National/International Conference proceedings with presentation certificate or a paper on the thesis work be communicated to a National/International Journal & accepted for publication for the submission of thesis at the end of 4th semester is mandatory.
2. Final Thesis should be submitted at the end of 4th semester and it will be evaluated by a committee consisting of Chairman Board of Studies, Head of the Department, External Examiner and thesis guide.
3. The candidate has to defend his thesis in a Viva-voce examination to be conducted by the above committee. The committee should submit a report, with signatures of all the members, candidate wise for 100 marks.

GUIDELINES FOR PREPARING THE REPORT OF PROJECT WORK

1.ARRANGEMENT OF CONTENTS:

The sequence in which the project report material should be arranged and bound should be as follows:

1. Cover Page &TitlePage
2. Bonafide Certificate
3. Abstract
4. Table ofContents
5. List ofTables
6. List of Figures
7. List of Symbols, Abbreviations andNomenclature
8. Chapters
9. Appendices
10. References

The tables and figures shall be introduced at appropriate places.

2.PAGE DIMENSION AND BINDINGSPECIFICATIONS:

The dimension of the project report should be in A4 size. The project report should be bound using flexible cover of the thick white art paper. The cover should be **printed in black letters** and the text for printing should be identical.

3.PREPARATIONFORMAT:

3.1. Cover Page & Title Page – A specimen copy of the Cover page & Title page of the project report are given in **Appendix 1.**

3.2 Bonafide Certificate – The Bonafide Certificate shall be in double line spacing using Font Style Times New Roman and Font Size 14, as per the format in **Appendix 2.** The certificate shall carry the supervisor's signature and shall be followed by the supervisor's name, academic designation (not any other responsibilities of administrative nature), department and full address of the institution where the supervisor has guided the student. The term **'SUPERVISOR' must** be typed in capital letters between the supervisor's name and academicdesignation.

3.3 Abstract – Abstract should be one page synopsis of the project report typed one and half line spacing, Font Style Times New Roman and Font Size12.

3.4 Table of Contents – The table of contents should list all material following it as well as any material which precedes it. The title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents but the page numbers of which are in lower case Roman letters. One and a half spacing should be adopted for typing the matter under this head. A specimen copy of the Table of Contents of the project report is given in **Appendix3.**

3.5 List of Tables – The list should use exactly the same captions as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under thishead.

3.6 List of Figures – The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under thishead.

3.7 List of Symbols, Abbreviations and Nomenclature – One and a half spacing shouldbe adopted or typing the matter under this head. Standard symbols, abbreviations etc. should be used.

3.8 Chapters – The chapters may be broadly divided into 3 parts (i) Introductory chapter, (ii) Chapters developing the main theme of the project work (iii) and Conclusion. The main text will be divided in to several chapters and each chapter may be further divided into several divisionsandsub-divisions.

- Each chapter should be given an appropriatetitle.
- Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they arecited.
- Footnotes should be used sparingly. They should be typed single space and placed directly underneath in the very same page, which refers to the material theyannotate.

3.9 Appendices

- Appendices are provided to give supplementary information, which is included in the main text may serve as a distraction and cloud the centraltheme.
- Appendices should be numbered using Arabic numerals, e.g. Appendix 1, Appendix 2,etc.
- Appendices, Tables and References appearing in appendices should be numbered and referred to at appropriate places just as in the case of chapters.
- Appendices shall carry the title of the work reported and the same title shall be made in the contents pagealso.

3.10 List of References –The listing of references should be typed 4 spaces below the heading "REFERENCES" in alphabetical order in single spacing left – justified. The reference material should be listed in the alphabetical order of the first author. The name of the author/authors should be immediately followed by the year and other details .A typical illustrative list given below relates to the citation example quotedabove.

REFERENCES:

1. Barnard, R.W. and Kellogg, C. (1980) Applications of Convolution Operators to Problems in Univalent Function Theory, Michigan Mach, J., Vol.27,pp.81–94.

2. Shin, K.G. and Mckay, N.D. (1984) Open Loop Minimum Time Control of Mechanical Manipulations and its Applications, Proc. Amer.Contr.Conf., San Diego, CA, pp.1231-1236.

4. TYPING INSTRUCTIONS:

The impression on the typed copies should be black in color. One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style Times New Roman and Font size 12 and chapter headings and subheadings shall be font size 14 and bold.