AICTE MODEL CURRICULUM
FOR
POST GRADUATE DEGREE COURSE
M.TECH
IN
COMPUTER SCIENCE AND TECHNOLOGY
[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

### Course Structure and Scheme of Valuation w.e.f. 2019-20

### I SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the subject</th>
<th>Periods/week</th>
<th>Max.Marks</th>
<th>Total</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td>Lab</td>
<td>Ext.</td>
<td>Int.</td>
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<tr>
<td>MTCST11</td>
<td>Mathematical Foundations of Computer Science</td>
<td>3</td>
<td>-</td>
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<tr>
<td>MTCST12</td>
<td>Advanced Data Structures</td>
<td>3</td>
<td>-</td>
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<td>MTCST13</td>
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<td>3</td>
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<td>MTCST15</td>
<td>Research Methodology &amp; IPR</td>
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<td>Organizational Behavior (Audit Course)</td>
<td>3</td>
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<td>3</td>
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<td>MTCST18</td>
<td>Elective – II Lab</td>
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**Total**: 18 6 520 280 800 18


**Elective II**: Advanced Database Management Systems/Computer Networks//Embedded systems

### II SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the subject</th>
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<td>Data Mining &amp; Data Warehousing</td>
<td>3</td>
<td>-</td>
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<td>MTCST22</td>
<td>Object Oriented Software Engineering</td>
<td>3</td>
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<td>Elective-III</td>
<td>3</td>
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<td>MTCST24</td>
<td>Elective-IV</td>
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<td>Data Mining &amp; Data Warehousing Lab</td>
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<tr>
<td>MTCST28</td>
<td>Mini Project With Seminar</td>
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</table>

**Total**: 15 9 450 350 800 18

**Elective III**: Artificial Intelligence/Cryptography & Network Security/Image Processing

**Elective IV**: Compiler Design/Mobile Computing/Soft Computing
### IIISemester

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the subject</th>
<th>Periods/week</th>
<th>Max. Marks</th>
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<td>MTCST31</td>
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<td>MTCST32</td>
<td>Open Elective</td>
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<tr>
<td>MTCST33</td>
<td>Dissertation - I/ Industrial project</td>
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<td><strong>6</strong></td>
<td><strong>240</strong></td>
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</table>

**Elective - V**: Big Data Analytics/Internet of Things/ Machine Learning

**Open Elective**: GPS Applications/Operation Research/4G – 5G Mobile Communication Networks

### IVSemester

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the subject</th>
<th>Periods/week</th>
<th>Max. Marks</th>
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</table>
# M.TECH (COMPUTER SCIENCE & TECHNOLOGY)

## PROGRAM EDUCATIONAL OBJECTIVE (PEO’S)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>PEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEO-1</td>
<td>To solve diverse and complex computer science and engineering problems across a broad range of areas and make them to become professionals</td>
</tr>
<tr>
<td>PEO-2</td>
<td>To prepare students to have successful career in industries, academia, research and entrepreneurial endeavours.</td>
</tr>
<tr>
<td>PEO-3</td>
<td>To mould them as lifelong learners</td>
</tr>
<tr>
<td>PEO-4</td>
<td>To prepare students to contribute to society as an ethical and responsible citizen.</td>
</tr>
</tbody>
</table>

## PROGRAM OUTCOMES (PO’S)

<table>
<thead>
<tr>
<th>PO</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO-1</td>
<td>Acquire domain specific knowledge to solve specific engineering complex problems.</td>
</tr>
<tr>
<td>PO-2</td>
<td>Able to independently carry out problem analysis, research/investigation and development work to solve practical problems.</td>
</tr>
<tr>
<td>PO-3</td>
<td>Design solutions to the domain specific complex engineering problems.</td>
</tr>
<tr>
<td>PO-4</td>
<td>Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis.</td>
</tr>
<tr>
<td>PO-5</td>
<td>Create, select, and apply appropriate techniques, resources, and modern engineering and it tools including prediction and modelling to complex engineering activities.</td>
</tr>
<tr>
<td>PO-6</td>
<td>Acquire professional integrity and ethics, understand the responsibility for sustainable development of the society</td>
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<td>------</td>
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</tr>
<tr>
<td>PO-7</td>
<td>Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
</tr>
<tr>
<td>PO-8</td>
<td>Understand and demonstrate management skills with commitment to lifelong learning, assess and evaluate the economic feasibility, work effectively as a leader and a team member</td>
</tr>
<tr>
<td>PO-9</td>
<td>Able to participate as an individual, and as a member or leader.</td>
</tr>
<tr>
<td>PO-10</td>
<td>Communicate effectively on complex engineering activities with the engineering community and with the society at large.</td>
</tr>
</tbody>
</table>

**PROGRAM SPECIFIC OUTCOMES (PSO’S)**

<table>
<thead>
<tr>
<th>PSO-1</th>
<th>Ability to design and develop software in latest technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSO-2</td>
<td>Ability to understand and get acquaintance with latest research and able to address the societal problems.</td>
</tr>
<tr>
<td>PSO-3</td>
<td>Ability to improve knowledge to simulate and implement solutions to real world problems.</td>
</tr>
</tbody>
</table>
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: 4  
| Internal: 30 Marks | External: 70 Marks | Total: 100 Marks  

**Course Objectives:**  
- Study the fundamental concepts of logic, abstract algebra, linear algebra, probability.  
- and statistics graph theory etc.  
- To give an overview of the theoretical foundations of computer science from the perspective of formal languages  
- To illustrate finite state machines to solve problems in computing.  
- To explain the hierarchy of problems arising in the computer sciences.  

**Course Outcomes:**  
By the end of the course, the student will be able to demonstrate:  
- Rewrite mathematical arguments using logical connectives and quantifiers and verify the validity of logical flow of arguments using propositional, predicate logic. Identify and give examples of various types of relations and describe various properties of the relations.  
- Ability to solve problems using permutations and combinations, determine isomorphism of graphs and spanning tree of a given graph using BFS/DFS algorithms, also determine minimal spanning tree of a given graph.  
- Ability to construct mathematical proofs of statements and find counterexamples to false statements in Number Theory.  
- understand the logic and methods behind the major proofs in Number Theory.  
- Ability to think analytically and intuitively for problem-solving situations in related areas of theory in computer science.  
- Ability to describe the language accepted by an automata or generated by a regular expression or a context-free grammar.  
- Ability to understand the functioning of Finite-State Machines, Deterministic Finite State Automata, Nondeterministic Finite-State Automata and Pushdown Automata and Turing Machines.  

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MTCST12  |  ADVANCED DATA STRUCTURES  
| Common for M.Tech(CST, IT, AI&R, CN, CS&DA)  

| Instruction: 3 Periods/week, | Time: 3 Hours | Credits: 4  
| Internal: 30 Marks | External: 70 Marks | Total: 100 Marks  

**Course Objectives:**
Understand and apply linear data structures - List, Stack and Queue
Understand the graph algorithms.
Learn different algorithms analysis techniques.
Apply data structures and algorithms in real time applications.
Able to analyse the efficiency of algorithm.

Course Outcomes:
- Student will be able to write programs to implement various trees.
- Ability to understand various hashing techniques.
- Ability to write programs to implement sorting techniques.
- Ability to understand concepts related to graph theory.

MTCST13 | Elective-I DISTRIBUTED OPERATING SYSTEMS
Common for M.Tech (CST, IT)

Instruction: 3 Periods/week, Time: 3 Hours | Credits: 4

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

Course Objectives:
- To study the concepts of Distributed Operating System
- Methods of understanding clock synchronization protocols
- Introduce the concepts of file system implementation in DOS.

Course Outcomes:
After the completion of this course, student will be able to
- Gain knowledge of distributed operating system architecture
- Illustrate principles and importance of distributed operating system.
- Implement distributed client server applications using remote method invocation.
- Distinguish between centralized systems and distributed systems.
- Create stateful and state-less applications.

MTCST13 | Elective-I
COMPUTER ORGANIZATION AND ARCHITECTURE
Common for M.Tech (CST, IT, AI&R, CN, CS & DA)

Instruction: 3 Periods/week, Time: 3 Hours | Credits: 4

Internal: 30 Marks | External: 70 Marks | Total: 100 Marks
Course Objectives:
- To have a thorough understanding of the basic structure and operation of a digital computer.
- To study the different ways of communicating with I/O devices and standard I/O interfaces.
- To learn the architecture and assembly language programming of 8085 interfaces.
- To study peripherals and their interfacing with 8085 microprocessors.

Course Outcomes:
- Knowledge about major components of a computer such as processor, memory, and I/O modules along with their interconnections internally with outside world.
- Detailed idea about architecture of central processing unit, functions of control unit, memory, I/O devices, and their issues.
- Simple and multiple processor organization and their issues.

<table>
<thead>
<tr>
<th>MTCST13</th>
<th>Elective-ICOMPUTERGRAPHICS</th>
<th>Common for M.Tech (CST, IT)</th>
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<tr>
<td>Instruction:3Periods/week, Time:3Hours</td>
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</tr>
<tr>
<td>Internal: 30Marks</td>
<td>External:70Marks</td>
<td>Total:100Marks</td>
</tr>
</tbody>
</table>

Course Objectives:
- The objective of this course is to understand the theoretical foundation as well as the practical applications of 2D and 3D graphics.

Course Outcomes:
- The students will understand graphics principles and graphics hardware.
- The students can demonstrate geometrical transformations.
- The students can create interactive graphics applications and demonstrate computer graphics animation.
- Implement standard algorithms to draw various graphics objects using C program.
- Develop programs for 2-D and 3-D Transformations.
- Use projections to visualize objects on view plane.
**Course Objectives:**

- To understand the basic concepts and terminology related to DBMS and Relational Database Design
- To design and implement Distributed Databases.
- To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports.

**Course Outcomes:**

- Evaluate different database designs and architecture.
- Understand advanced querying and decision support system.
- Exposure for students to write complex queries including full outer joins, self-join, sub queries, and set theoretic queries.
- Knowhow of the file organization, Query Optimization, Transaction management, and database administration techniques
- Assess and apply database functions of distributed database.

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**Course Objectives:**

- Build an understanding of the fundamental concepts of computer networking.
- Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
- Independently understand basic computer network technology.

**Course Outcomes:**

- The student must be able to understand the design and estimate the requirements...
ts for practical setup of a given network scenario and size.

- Realize the Operation, maintenance, and management of the Internet by mapping the theoretical networking concepts to the real-time networks scenarios.
- Demonstrate the applications of wireless Networks and overview of advanced networking concepts.
- Identify different networking devices and their usage and functionality.

### Course Objectives:

- To get familiarized with the embedded hardware architecture.
- To acquire knowledge about various embedded software development tools.
- To get an insight over various Wired and wireless communication protocols used in embedded system design.
- To understand the basics of RTOS.
- To build knowledge on programming and realize the concept of peripheral interface.

### Course Outcomes:

- Student will be understanding the basic architecture of 8051 microcontroller.
- Ability to write ALP programs using 8051 instruction set.
- Ability to understand the concepts related to RTOS and its Inter Task Communication methods.
- Ability to understand various design issues of RTOS.
- Understand about embedded software development tools.

### RESEARCH METHODOLOGY AND IPR

**Course Objectives:**

- To give an overview of the research methodology and explain the technique of defining research problem.
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and
conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.

**Course Outcomes:**
At the end of the course students will be able to
- Identify the suitable research methods and articulate the research steps in a proper sequence for the given problem.
- Carry out literature survey, define the problem statement and suggest suitable solution for the given problem and present in the format of the research paper (IEEE).
- Analyse the problem and conduct experimental design with the samplings.
- Perform the data collection from various sources segregate the primary and secondary data.

<table>
<thead>
<tr>
<th>MTCST16</th>
<th>Organizational Behavior (Audit Course)</th>
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<tr>
<td></td>
<td>Common for M.Tech (CST, IT, AI&amp;R, CN, CS&amp;DA)</td>
</tr>
</tbody>
</table>

**Instruction:** 3 Periods/week, **Time:** 3 Hours, **Credits:** 4

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

**Course Objectives:**
The objective of the course is to provide the students with the conceptual framework and the theories underlying Organizational Behavior

**Course Outcomes:**
After completing this chapter, you will be able to
- Define Organizational Behaviour
- Identify the function and principle of organisational behaviour.
- Discuss various models of man, self-actualisation man and complex man
- Understand the need for study of organisational behaviour.
- Synchronize various factors responsible for increase in diversity of human.
- resources. Analyse the contribution of various discipline to organisational behavior
- Understand the model of organisational behaviour

<table>
<thead>
<tr>
<th>MTCST17</th>
<th>ADVANCEDDATASTRUCTURESLAB</th>
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<tbody>
<tr>
<td></td>
<td>Common for M.Tech (CST, IT, AI&amp;R, CN, CS&amp;DA)</td>
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</tbody>
</table>
**Course Objectives:**
- Implement linear and nonlinear data structures.
- Analyze various algorithms based on their time complexity.
- Choose appropriate data structure and algorithm design method for a specific application.
- Identify suitable data structure to solve various computing problems.

**Course Outcomes:**
- Student will be able to write programs to implement stacks and queues.
- Ability to implement various searching and sorting techniques.
- Ability to implement programs using trees and graphs.

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**MTCST18**

Elective II Lab

ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

Common for M.Tech (CST, IT)

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

<table>
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<tr>
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<th>External: 70 Marks</th>
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</table>

**Course Objectives:**
- To understand the basic concepts and terminology related to DBMS and Relational Database Design
- To the design and implement Distributed Databases.
- To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports.

**Course Outcomes:**
- Exposure for students to write complex queries including full outer joins, self-join, sub queries, and set theoretic queries.
- Knowhow of the file organization, Query Optimization, Transaction management, and database administration techniques

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**MTCST19**

Elective II Lab

COMPUTERNETWORKSLAB

Common for M.Tech (CST, IT)

Instruction: 3 Periods/week, Time: 3 Hours, Credits: 4

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<th>Internal: 30 Marks</th>
<th>External: 70 Marks</th>
<th>Total: 100 Marks</th>
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</thead>
</table>
**Course Objectives:**
- To understand the functionalities of various layers of OSI model
- To develop an understanding of computer networking basics.
- To develop an understanding of different components of computer networks, various protocols, modern technologies and their applications.

**Course Outcomes:**
- Apply channel allocation, framing, error and flow control techniques.
- Describe the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism
- To understand how to use TCP and UDP based sockets and their differences

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**Course Objectives:**
- To enable the students to program, simulate and test the 8085, 8051, PIC 18 and ARM processor-based circuits and their interfaces
- To enable the students to program various devices using FLOWCODE, KIEL, MPLAB, XILINX ISE software.
- To provide a platform for the students to do multidisciplinary projects.
- To facilitate the conduct of short-term programmes.

**Course Outcomes:**
- Understand what is a microcontroller, microcomputer, embedded system.
- Understand different components of a microcontroller and their interactions.
- Become familiar with programming environment used to develop embedded systems.
- Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral devices.
- Learn debugging techniques for an embedded system.
### Data Mining & Data Warehousing

<table>
<thead>
<tr>
<th>MTCST21</th>
<th>Data Mining &amp; Data Warehousing</th>
</tr>
</thead>
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<td>Time: 3 Hours</td>
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<td>Credits: 4</td>
<td></td>
</tr>
<tr>
<td>Internal: 30 Marks</td>
<td>External: 70 Marks</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- The student should be made to
  - Be familiar with the concepts of data warehouse and data mining
  - Be acquainted with the tools and techniques used for Knowledge Discovery in Databases.

**Course Outcomes:**
- The student understands the differences between OLTP and OLAP.
- The student learns how data cube technology supports summarization and querying high dimensional data.
- The student is introduced to similarity, distance, information gain and other performance and error metrics used for evaluation of mining results.

### OBJECT ORIENTED SOFTWARE ENGINEERING

<table>
<thead>
<tr>
<th>MTCST22</th>
<th>OBJECT ORIENTED SOFTWARE ENGINEERING</th>
</tr>
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<tr>
<td>Credits: 4</td>
<td></td>
</tr>
<tr>
<td>Internal: 30 Marks</td>
<td>External: 70 Marks</td>
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</tbody>
</table>

**Course Objectives:**
- This course aims to give students both a theoretical and a practical foundation in Object-Oriented software engineering.
- In the theoretical part, students will learn about the principles and methods of Object Oriented software engineering, including current and emerging Object Oriented software engineering practices and support tools.
- In the practical part, students will become familiar with the development of Object Oriented software products from an industry perspective.
**Course Outcomes:**
- Ability to define a problem and perform Requirements Engineering.
- Ability to draw UML diagrams for the requirements gathered.
- Ability to implement the designed problem in Object-Oriented Programming Language and Test whether all the requirements specified have been achieved or not.

### MTCST23

**ELECTIVE-III**

**ARTIFICIAL INTELLIGENCE**

<table>
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<tr>
<th>Instruction: 3 Periods/week,</th>
<th>Time: 3 Hours</th>
<th>Credits: 4</th>
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<tbody>
<tr>
<td>Internal: 30 Marks</td>
<td>External: 70 Marks</td>
<td>Total: 100 Marks</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence that includes problem solving, Searching Techniques, knowledge representation, logics, reasoning, planning, perception & action, and learning.
- To learn about AI problem, Production Systems and their characteristics.
- To understand the importance of search and the corresponding search strategies for solving AI problem.
- Become familiar with basic principles of AI toward knowledge representation, logic and Reasoning.
- Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks.

**Course Outcomes:**
- Understands the history of Artificial Intelligence and its foundations.
- Familiarizes with knowledge representation issues and concepts.
- Obtains the knowledge to represent the language sentences using predicate logic.
- Gains awareness about expert system.
- Develops awareness on neural networks models.

### MTCST23

**Elective-III**

**Cryptography & Network Security**

<table>
<thead>
<tr>
<th>Instruction: 3 Periods/week,</th>
<th>Time: 3 Hours</th>
<th>Credits: 4</th>
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</thead>
<tbody>
<tr>
<td>Internal: 30 Marks</td>
<td>External: 70 Marks</td>
<td>Total: 100 Marks</td>
</tr>
</tbody>
</table>
**Course Objectives:**
- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability to Understand various cryptographic algorithms.
- Understand the basic categories of threats to computers and networks
- Describe public-key cryptosystem.
- Describe the enhancements made to IPv4 by IPSec
- Understand Intrusions and intrusion detection

**Course Outcomes:**
- Student will be able to understand basic cryptographic algorithms, message and web authentication and security issues.
- Ability to identify information system requirements for both of them such as client and server.
- Ability to understand the current legal issues towards information security

<table>
<thead>
<tr>
<th>MTCST23</th>
<th>ELECTIVE-III IMAGEPROCESSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction:3Periods/week,</td>
<td>Time:3Hours</td>
</tr>
<tr>
<td>Internal: 30Marks</td>
<td>External:70Marks</td>
</tr>
</tbody>
</table>

**Course Objectives:**
- Study fundamental concepts of Image Processing and various Image Transforms
- Familiarize with fundamentals of Image compression, Lossy & Lossless Compression methods. Define concepts of Video Processing, Image Formation models, and processing of Video signals.
- Understand general methodologies of 2 D Motion Estimation and Video coding methods.
Course Outcomes:

After completing this course, the student will be able to:

- Use different transforms for various applications like Image Enhancement, Compression etc.
- Use Spatial and Transform techniques to Enhance the given image and to extract the features of the image.
- Use Lossless and Lossy compression techniques for real time applications.
- Understand the fundamental concepts of Video capturing and Three Dimensional Motion Models.
- Understand and analyse various Motion estimation techniques.

<table>
<thead>
<tr>
<th>Course</th>
<th>ELECTIVE-IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTCST24</td>
<td>COMPILER DESIGN</td>
</tr>
<tr>
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<td>Time:3Hours</td>
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<tr>
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<td>External:70Marks</td>
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<tr>
<td>Total:100Marks</td>
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</tr>
</tbody>
</table>

Course Objectives:

- Introduce the major concepts of language translation and compiler design and impart the knowledge of practical skills necessary for constructing a compiler.
- Topics include phases of compiler, parsing, syntax directed translation, type checking use of symbol tables, code optimization techniques, intermediate code generation, code generation and data flow analysis

Course Outcomes:

- Demonstrate the ability to design a compiler given a set of language features
- Demonstrate the knowledge of patterns, tokens & regular expressions for lexical analysis. Acquire skills in using lex tool & yacc tool for developing a scanner and parser.
- Design and implement LL and LR parsers
- Design algorithms to do code optimization in order to improve the performance of a program in terms of space and time complexity.
- Design algorithms to generate machine code

<table>
<thead>
<tr>
<th>Course</th>
<th>ELECTIVE-IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTCST24</td>
<td>MOBILE COMPUTING</td>
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<td>Instruction:3Periods/week,</td>
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<tr>
<td>Total:100Marks</td>
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</tr>
</tbody>
</table>
Course Objectives:
- Define Mobile Computing and look at current trends
- To learn about the concepts and principles of mobile computing;
- To explore both theoretical issues of mobile computing;
- To develop skills of finding solutions and building software for mobile computing applications.

Course Outcomes:
- Acquires concepts and features of cellular technologies and mobile services.
- Gains knowledge on Wireless-LAN’s and their standards.
- Identifies the important issues of wireless networks and protocol mechanisms.
- Learns the functionalities of database in mobile communications and issues.
- Familiarizes with Mobile IP and Wireless Application Protocol.

| MTCST24 | ELECTIVE-IV 
SOFT COMPUTING |
<table>
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<tbody>
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<tr>
<td>Total: 100 Marks</td>
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</tbody>
</table>

Course Objectives:
Familiarize with soft computing concepts
- Introduce and use the idea of fuzzy logic and use of heuristics based on human experience
- Familiarize the Neuro-Fuzzy modeling using Classification and Clustering techniques
- Learn the concepts of Genetic algorithm and its applications
- Acquire the knowledge of Rough Sets.

Course Outcomes:
On completion of this course, the students will be able to:
- Identify the difference between Conventional Artificial Intelligence to Computational Intelligence.
- Understand fuzzy logic and reasoning to handle and solve engineering problems
- Apply the Classification and clustering techniques on various applications.
- Understand the advanced neural networks and its applications
- Perform various operations of genetic algorithms, Rough Sets.
- Comprehend various techniques to build model for various applications

<table>
<thead>
<tr>
<th>MTCST25</th>
<th>ENTREPRENEURSHIP (AUDITCOURSE)</th>
</tr>
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<tbody>
<tr>
<td>Common for M.Tech(CST,IT,AI&amp;R,CS&amp;DA and CN)</td>
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</tbody>
</table>
Instruction: 3 Periods/week, Time: 3 Hours, Credits: 4

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

Course Objectives:
- To familiarize the students with the concepts of Management.
- To relate the concepts of Management with industrial organizations.
- To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.
- To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:
- On completion of the course, the students will be able to:
  - Understand the roles, skills, and functions of management.
  - Distinguish the different types of business organizations.
  - Identify the factors involved in Production Operations Management.
  - Diagnose organizational problems and take suitable decisions.
  - Establish good Human Resource Management practices.
  - Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

MTCST26
OBJECT ORIENTED SOFTWARE ENGINEERING LAB
Common for M.Tech (CST, IT)

Instruction: 3 Periods/week, Time: 3 Hours, Credits: 4

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

Course Objectives:
- Main objective of this lab is to enable the student to practice the object-oriented analysis and design through UML on a particular application (project).
- Understand how UML supports the entire OOAD process.
- Become familiar with all phases of OOAD

Course Outcomes:
- To Design & implement complex software solutions using state of the art software solutions using state of art software Engineering Techniques.
- To provide working knowledge of UML (Unified Modeling Languages) Sources control and project Management.
- To provide working knowledge of the technologies essentially for incorporating in the project.
- To expertise for testing and document software
**MTCST27**  
**DATAMINING & DATA WAREHOUSING LAB**

- Instruction: 3 Periods/week, Time: 3 Hours, Credits: 4
- Internal: 30 Marks, External: 70 Marks, Total: 100 Marks

**Course Objectives:**
- To apply the various data mining techniques available in WEKA for generating knowledge such as Association Analysis, Classification and Clustering to various standard datasets and own datasets.
- The main objective of this lab is to impart the knowledge on how to implement classical models and algorithms in data warehousing and data mining and to characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.
- At the end to compare and contrast different conceptions of data mining.
- To demonstrate the knowledge retrieved through solving problems.

**Course Outcomes:**
- Practices creating dataset in ARFF format.
- Learns to convert excel data sheets to ARFF.
- Applies knowledge on mining frequent patterns using apriori algorithm.
- Ability to design real time classification applications.
- Implements real time clustering techniques using WEKA tool.

---

**MTCST31**  
**ELECTIVE-V**  
**BIGDATA ANALYTICS**

- Instruction: 3 Periods/week, Time: 3 Hours, Credits: 4
- Internal: 30 Marks, External: 70 Marks, Total: 100 Marks

**Course Objectives:**
- Understand big data and Apache Hadoop Eco-system.
- Understand distributed, parallel, cloud computing and SQL concepts.
- Apply Hadoop concepts.
- Understand concepts of map and reduce and functional programming.

**Course Outcomes:**
- Gain conceptual understanding of analytics concepts, algorithms and statistical tests.
- Gains knowledge on how to analyze data by using various classification and clustering techniques.
- Understands how Hadoop can store and process the data and its architecture.
- Ability to learn how to read and write data in Hadoop distributed file system.

<table>
<thead>
<tr>
<th>MTCST31</th>
<th>ELECTIVE-V</th>
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<td>📜 INTERNET OF THINGS</td>
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<td>Total: 100 Marks</td>
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<tr>
<td></td>
<td>External: 70 Marks</td>
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</table>

Course Objectives:
- To understand how sensors and embedded systems work
- To understand how to program on embedded and mobile platforms including ESP8266 and Android
- To understand how to make sensor data available on the Internet.
- To understand how to analyze and visualize sensor data.
- To understand how to work as a team and create end-to-end IoT applications.

Course outcomes:
- Understands the concepts and devices of IoT.
- Familiarizes with IoT networking basics.
- Learns about various connectivity protocols and their applications.
- Ability to design IoT applications using Arduino programming.
- Understands the role of big data and cloud computing in IoT.

<table>
<thead>
<tr>
<th>MTCST31</th>
<th>ELECTIVE-V</th>
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<td>📜 MACHINE LEARNING</td>
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</table>

Course Objectives:
- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.
- Explore supervised and unsupervised learning paradigms of machine learning.

Course outcomes:
- Understand the concepts of computational intelligence like machine learning.
- Ability to get the skill to apply machine learning techniques to address the real time
problems.

- in different areas
- Understand the Neural Networks and its usage in machine learning application.

### MTCST32
**OPEN ELECTIVE**
**GPS APPLICATIONS**

<table>
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<tbody>
<tr>
<td>Internal: 30 Marks</td>
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</tbody>
</table>

**Course Objectives:**
This course will provide fundamental information on the global positioning system (GPS). Topics to be introduced include the history and development of navigation and GPS, an overview of the technological requirements for the system, a review on how the system works, and a discussion of various applications that can incorporate a GPS.

**Course Outcomes:**
Upon completion of this course, students will be able to:
- Describe the basic concept of the global positioning system
- Describe the satellites and signal structures used in the GPS system
- Explain the process and importance of differential correction
- Describe the factors that increase the accuracy of a GPS receiver
- Describe the potential errors in locating a position
- Utilize a GPS receiver to acquire data
- Utilize associated software to import data.

### MTCST31
**OPEN ELECTIVE**
**OPERATION RESEARCH**

<table>
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<th>Instruction: 3 Periods/week,</th>
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<tbody>
<tr>
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</tr>
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</table>

**Course Objectives:**
Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it

**Course Outcomes:**
- Ability to solve LPP problems using various methods.
- Ability to solve transportation and assignment problems using several methods.
- Analyze the PERT and CPM charts
- Ability to solve replacement problems and game theory problems.
Course Objectives:
The student should be made to:

- Understand the basic concepts of mobile computing
- Understand Wireless LAN, Bluetooth and Wi-Fi Technologies
- Be familiar with the network protocol stack
- Learn the basics of mobile telecommunication system.
- Be exposed to Ad-Hoc networks.

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

- Explain the basics of mobile telecommunication system.
- Illustrate the generations of telecommunication systems in wireless network.
- Understand the architecture of Wireless LAN technologies.
- Determine the functionality of network layer and Identify a routing protocol for a given Ad hoc networks
- Explain the functionality of Transport and Application layer
AICTE MODEL CURRICULUM
FOR
POST GRADUATE DEGREE COURSE
M.TECH
IN
COMPUTER SCIENCE AND TECHNOLOGY
[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
Course Structure and Scheme of Valuation w.e.f. 2019-20

I SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Name of the subject</th>
<th>Periods/week</th>
<th>Max. Marks</th>
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Elective II: Advanced Database Management Systems/Computer Networks/Embedded systems

II SEMESTER

<table>
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<td>MTCST22</td>
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Elective IV: Compiler Design/Mobile Computing/Soft Computing
### IISEMESTER

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<th>Periods/week</th>
<th>Max. Marks</th>
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<td>Lab</td>
<td>Ext.</td>
<td>Int.</td>
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<tr>
<td>MTCST31</td>
<td>Elective-V</td>
<td>3</td>
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<td>MTCST32</td>
<td>Open Elective</td>
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</table>

**Elective-V**: Big Data Analytics/Internet of Things/ Machine Learning

**Open Elective**: GPS Applications/Operation Research/4G – 5G Mobile Communication Networks

### IVSEMESTER

<table>
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<tr>
<th>Code</th>
<th>Name of the subject</th>
<th>Periods/week</th>
<th>Max. Marks</th>
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FIRST SEMESTER
DETAILED SYLLABUS FOR M.TECH (CST)

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:30 Marks               External:70 Marks     Total: 100 Marks

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.


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 & undecidable problems- Post Correspondence Problems

Text books:
1. Introduction to Automata Theory, Languages and Computations – J.E. Hopcroft, & J.D. Ullman, Pearson Education Asia.

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)
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.
MTCST13 Elective-I
DISTRIBUTED OPERATING SYSTEMS
Common for M.Tech (CST, IT)

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-3: Synchronization in Distributed System, Clock Synchronization, Mutual Exclusion, Election algorithms, Atomic transactions, Deadlocks in Distributed Systems.

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


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

TEXT BOOK:
Distributed Operating Systems, Andrew S. Tanenbanm

Reference Book:
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 and Design:**
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 programmed Control:**
Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.

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

5. **Input/output Organization:**
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:**

**Text Book:**

**Reference Book:**
MTCST13 Elective-I COMPUTER GRAPHICS
Common for M.Tech (CST, IT)

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


5. Viewing Pipeline and Clipping operations: Viewing Pipeline, Viewing Coordinates & Reference frames, Window-to-Viewport Coordinate Transformation, Two Dimensional Viewing Functions, Three Dimensional Viewing, View Volumes, Clipping and its Operations, Types of clipping operations - Point Clipping, Line Clipping, Polygon Clipping, Curve Clipping, Text and Exterior Clipping.

6. Three Dimensional Concepts and Object representations: 3D display methods, 3D Graphics, Polygon Surfaces, Curved Lines and Surfaces, Quadratic Surfaces, Super Quadrics, Blobby Objects, Spline Representations, Cubic Spline methods, Bézier Curves and Surfaces, B-Spline Curves and Surfaces.


Text Books:
2. Computer Graphics by Dr. Rajiv Chopra.

Reference Books:
UNIT-1: **Advanced SQL**: SQL Data Types and Schemas, Integrity Constraints, Authorization, Embedded SQL, Dynamic SQL, Functions and Procedural Constructs, Recursive Queries, Advanced SQL Features.

**Object-Based Databases and XML**: Complex Data Types, Structured Types and Inheritance in SQL, Table Inheritance, Array and Multi set Types in SQL, Object-Identity and Reference Types in SQL, Implementing O-R Features, Persistent Programming Languages, Object-Oriented versus Object-Relational, Structure of XML Data, XML Document Schema, Querying and Transformation, Application Program Interfaces to XML, Storage of XML Data, XML Applications.


UNIT-5: **Distributed Databases**: Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases.


**Text Books**


**Reference Books**

1. **Introduction to Computer Networks**: Introduction, Network Hardware, Network Software, OSI and TCP/IP Reference Models

2. **Data Communications**: Transmission Media, Wireless Transmission, Transmission in ISDN, Broad Band ISDN, ATM Networks,

3. **Design Issues in Data Link Layer**: Data Link Control, Error Detection & Correction, Sliding Window Protocols, IEEE Standards 802.2, 802.3, 802.4, 802.5, 802.6, Over view of High Speed LANs.


5. **Internet Transport Protocols**: Transport Service, Elements of Transport Protocols, TCP and UDP Protocols

6. **Over View of**: DNS, SNMP, Electronic Mail, FTP, TFTP, BOOTP, HTTP Protocols

7. **Over View of Network Devices**: Repeaters, Bridges, Routers, Gateways, Multiprotocol Routers, Brouters, Switches, Modems, Channel Service Unit CSU, Data Service Units DSU, NIC, Wireless Access Points, Transceivers, Firewalls, Proxies.


**Text Book:**

**References:**
2. Computer networks, Mayank Dave, CENGAGE.


7. **Host and Target Machines** – Linker/Locator for Embedded Software- Getting Embedded Software into the Target System.


**Text Book:**


**Reference Book:**

MTCST15 RESEARCH METHODOLOGY AND IPR
Common for M.Tech (CST, IT, AI&R, CN, CS&DA)

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

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

---

**Unit 1:**
- Meaning of research problem
- Sources of research problem
- Criteria: Characteristics of a good research problem
- Errors in selecting a research problem
- Scope and objectives of research problem
- Approaches of investigation of solutions for research problem
- Data collection, analysis, interpretation, Necessary instrumentations

**Unit 2:**
- Effective literature studies approaches, analysis, Plagiarism, Research ethics

**Unit 3:**
- Effective technical writing, how to write report
- Developing a Research Proposal
- Format of research proposal, a presentation and assessment by a review committee

**Unit 4:**
- Nature of Intellectual Property: Patents, Designs, Trade and Copyright
- Process of Patenting and Development: technological research, innovation, patenting, development
- International Scenario: International cooperation on Intellectual Property
- Procedure for grants 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 developments in IPR: IPR of Biological Systems, Computer Software etc.
- Traditional knowledge Case Studies, IPR and IITs

**References:**
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
UNIT-I: Organizational Behavior: Concept of Organization - Concept of Organizational Behavior - Nature of Organizational Behavior - Role of Organizational behavior - Disciplines contributing to Organizational Behavior.

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.


Text Books.

1. L.M. Prasad: Organizational Behavior, Sultan Chand & Sons, New Delhi - 110002

Reference Books.

1. Write Java programs that use both recursive and non-recursive functions for implementing 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) Inorder
    c) 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) Insertion sort
    e) Heap sort
    d) Merge sort
    g) Binary tree sort
c) Quick sort  
f) 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 cost spanning tree.

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

REFERENCE BOOKS:


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


MTCST18 Elective-II Lab

ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

Common for M.Tech (CST, IT)

<table>
<thead>
<tr>
<th>Instruction: 3 Periods/week</th>
<th>Time: 3 Hours</th>
<th>Credits: 2</th>
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<tr>
<td>Internal: 50 Marks</td>
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Experiments

- Basic SQL
- Intermediate SQL
- Advanced SQL
- ER Modeling
- Database Design and Normalization
- Accessing Databases from Programs using JDBC
- Building Web Applications using PHP & MySQL
- Indexing and Query Processing
- Query Evaluation Plans
- Concurrency and Transactions
- Big Data Analytics using Hadoop

Outcome:

- Ability to use databases for building web applications.
- Gaining knowledge about the internals of a database system.

References


Network Programming
1. Socket Programming
   a. TCP Sockets
   b. UDP Sockets
   c. Applications using Sockets
2. Simulation of Sliding Window Protocol
3. Simulation of Routing Protocols
4. RPC
5. Development of applications such as DNS/ HTTP/ E-mail/ Multi-user Chat

Web Programming
1. Design of the Web pages using various features of HTML and DHTML
2. Client server programming using servlets, ASP and JSP on the server side and JavaScript on the client side
3. Web enabling of databases
4. Multimedia effects on web pages design using Flash.

Reference Books:
1. Internet and Web Technologies by Raj Kamal, Tata McGraw-Hill
MTCST18 Elective II Lab
Embedded Systems LAB
Common for M.Tech (CST, IT)

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

PART- I:
1. Simple Assembly Program for
   Addition | Subtraction | Multiplication | Division
   Operating Modes, System Calls and Interrupts, Loops, Branches
2. Write an Assembly programs to configure and control General Purpose Input/Output (GPIO) port pins.
3. Write an Assembly programs to read digital values from external peripherals and execute them with the Target board.
4. Program for reading and writing of a file
5. Program to demonstrate Time delay program using built in Timer / Counter feature on IDE Environment
6. Program to demonstrates a simple interrupt handler and setting up a timer
7. Program demonstrates setting up interrupt handlers. Press button to generate an interrupt and trace program flow with debug terminal.
8. Program to Interface 8 Bit LED and Switch Interface
9. Program to implement Buzzer Interface on IDE environment
10. Program to Displaying a message in a 2 line x 16 Characters LCD display and verify the result in debug terminal.
11. Program to demonstrate I2C Interface on IDE environment
12. Program to demonstrate I2C Interface – Serial EEPROM
13. Demonstration of Serial communication. Transmission from Kit and reception from PC using Serial Port on IDE environment use debug terminal to trace the program.
14. Generation of PWM Signal
15. Program to Interface 8 Bit LED and Switch Interface
16. Program to implement Buzzer Interface on IDE environment

PART- II:
Write the following programs to understand the use of RTOS with ARM Processor on IDE Environment using ARM Tool chain and Library:
1. Create an application that creates two tasks that wait on a timer whilst the main task loops.
2. Write an application that creates a task which is scheduled when a button is pressed, which illustrates the use of an event set between an ISR and a task
3. Write an application that Demonstrates the interruptible ISRs (Requires timer to have higher priority than external interrupt button)
4. a). Write an application to Test message queues and memory blocks.
   b). Write an application to Test byte queues
5. Write an application that creates two tasks of the same priority and sets the time slice period to illustrate time slicing.
   Interfacing Programs:
6. Write an application that creates a two task displaying two different messages in LCD display in twolines.
7. Write an application that creates a two task displaying two different messages in LCD display intwolines.
8. Sending messages to mailbox by one task and reading the message from mailbox by another task.
9. Sending message to PC through serial port by three different tasks on priority Basis.
10. Basic Audio Processing on IDE environment.
SECOND SEMESTER
DETAILED SYLLABUS FOR M.TECH (CST)

MTCST21 Data Mining & Data Warehousing

Instruction: 3 Periods/week
Internal: 30 Marks

Time: 3 Hours
Credits: 3
External: 70 Marks
Total: 100 Marks

1. **Introduction to Data Mining:** Motivation and importance of Data Warehousing and Data Mining, Kinds of Data, Kinds of Patterns, Technologies, Data Mining Applications Data Objects and Attributes Types, Statistical Descriptions of Data, Data Visualization, Estimating Data Similarity and Dissimilarity

2. **Data Preprocessing** Pre-processing the Data, Data Cleaning, Data Integration, Data Reduction, Data Transformation, Discretization and Concept Hierarchy Generation;

3. **Data Warehouse and OLAP Technology:** Basic Concepts of Data warehouse, Data Modeling using Cubes and OLAP, DWH Design and usage, Implementation of Data Warehouse, OLAP servers, Data Generalization with AI.

4. **Data Cube Technology:** Preliminary Concepts of Data Cube Computation, Data Cube Computation Methods: Multi-way Array Aggregation for Full Cube, BUC Computing for Iceberg Cubes, Star-Cubing Using Dynamic Star-Tree Structure, Pre-computing Shell Fragments for Fast High-Dimensional OLAPs.

5. **Mining Frequent Patterns Based on Associations and Correlations:** Basic Concepts, Frequent Itemset Mining Methods: Apriori Algorithm, Association Rule Generation, Improvements to Apriori, FP-Growth Approach, Mining Frequent Patterns using Vertical Data Formats, Mining Closed and Max Patterns, Pattern Evaluation Methods

6. **Classification:** Basic Concepts, Decision Tree Induction, Bayes Classification, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy, Classification by Back Propagation, SVM, Lazy Learning, Fuzzy Sets, Rough Sets, Genetic Algorithms, Multiclass Classification, Semi-Supervised Classification

7. **Cluster Analysis:** Basic Concepts, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Evaluation of Clustering Solutions

**Text Book:**
Data Mining- Concepts and Techniques by Jiawei Han, Micheline Kamber and Jian Pei --Morgan Kaufmann publishers ---3rd edition

**References:**
1. Data Mining Techniques, A.K. Pujari, University Press Data mining concepts by Tan, Steinbech, and Vipin Kumar - Pearson Edupublishers
2. Data Mining – Introductory and Advanced by Margarett Dunham -- Pearson Education publishers
3. Data Warehousing for Real –world by Sam Annahory-- Pearson Education publishers
1. Introduction to Object Oriented Software Engineering

2. Requirements Engineering: Domain Analysis, Problem Definition And Scope, Requirements Definition, Types Of Requirements, Techniques For Gathering And Analyzing Requirements, Requirement Documents, Reviewing, Managing Change In Requirements.


Text Book:

Object-Oriented Software Engineering Practical software development using UML and Java by Timothy C. Lethbridge & Robert, LanganereMcgraw-Hill

References:


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, Hebbian Learning.

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, Reactive Systems

**Text Book:**

1. Artificial Intelligence, George F Luger, Pearson Education Publications

**References:**

1. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI
3. Artificial Intelligence: A modern Approach, Russell and Norvig, Printice Hall
MTCS T23 Elective-III Cryptography & Network Security

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**TextBook:**

**Reference Books:**
MTCST23  ELECTIVE-III  IMAGE PROCESSING

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

3. **Image Enhancement:**
   a. Arithmetic and Logical Operations, Pixel or Point Operations, Size Operations,
   b. Smoothing Filters – Mean, Median, Mode Filters – Comparative Study
   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. – Comparative Study
   f. Colour Fundamentals and Colour Models
   g. Colour Image Processing.


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 Compression Standards.

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, Split and Merge Technique, Motion in Segmentation

7. **Morphology:** Dilation, Erosion, Opening, Closing, Hit-And-Miss Transform, Boundary Extraction, Region Filling, Connected Components, Thinning, Thickening, Skeletons, Pruning, Extensions to Gray-Scale Images. Application of Morphology in IP.

8. **Image, Video & Multimedia Communications:** Multi-scale and multi-orientation representation; Geometry and texture representation; Object based representation; Hierarchical representation; Sparse representation,

**Text Books:**
Digital Image Processing, Rafael C. Gonzalez And Richard E. Woods, Addison Wesley

**Reference Books:**


7. Symbol Table Management: Contents of a Symbol Table, Data Structures for Symbol Tables; Run time Environments, Implementation of a simple Stack allocation, Heap Management, Block Structured Languages; Error Detection & Recovery, Lexical Phase Errors, Syntactic & Semantic Errors, Error Handling Routines.

**Text Books:**


2. *Advanced Compiler Design and Implementation*, Steven Muchnic, Elsevier Publications

**Reference Books:**

MTCST24   ELECTIVE-IV MOBILE COMPUTING

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3. **WLAN Topologies**, WLAN Standard IEEE 802.11, Comparison Of IEEE 802.11a, B, G and N Standards, Wireless PANs, Hiper LAN, Wireless Local Loop, ATM, Virtual Private Networks, Wireless Data Services, Common Channel Signaling, Various Networks for Connecting to The Internet.


5. **Communications** Asymmetry, Classification of New Data Delivery Mechanisms, Push-Based Mechanisms, Pull-Based Mechanisms, Hybrid Mechanisms, Selective Tuning (Indexing) Techniques. CDMA & GSM, Wireless Data, 3G Networks and Applications


Text Books:


Reference Books:


## MTCST24 ELECTIVE-IV SOFT COMPUTING

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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:**
2. Fuzzy Logic With Engineering Application, Timothy J.Ross, John Wiley & Sons PublishingCompany
MTCST25 ENTREPRENEURSHIP (AUDIT COURSE)
Common for M.Tech (CST, IT, AI&R, CS&DA and CN)

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

Unit - I
Basic Concepts of Management: Management :- Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management.

Unit - II
Forms of Business Organizations: Introduction, Types of Business organizations; Private Sector- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

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.

Unit - IV

Unit - V

Text Books:

Reference Books:
2. Sheela, P., and JagadeswaraRao, K., Entrepreneurship, Shree Publishing House, Guntur,
1. The purpose of the Software Engineering Lab course is to familiarize the students with modern software engineering methods and tools, Rational Products. The course is realized as a project-like assignment that can, in principle, by a team of three/four students working full time. Typically the assignments have been completed during the semester requiring approximately 60-80 hours from each project team.

2. The goal of the Software Engineering Project is to have a walk through from the requirements, design to implementing and testing. An emphasis is put on proper documentation. Extensive hardware expertise is not necessary, so proportionate attention can be given to the design methodology.

3. Despite its apparent simplicity, the problem allows plenty of alternative solutions and should be a motivating and educating exercise. Demonstration of a properly functioning system and sufficient documentation is proof of a completed assignment.

4. Term projects are projects that a group student or might take through from initial specification to implementation. The project deliverables include:

   - Documentation including
     - A problem statement
     - A requirements document
     - A Requirements Analysis Document.
     - A System Requirements Specification.
     - A Software Requirements Specification.
     - A design document
     - A Software Design Description and a System Design Document.
     - A test specification.
     - Manuals/guides for
       - Users and associated help frames
       - Programmers
       - Administrators (installation instructions)

   - A project plan and schedule setting out milestones, resource usage and estimated costs.
   - A quality plan setting out quality assurance procedures
   - An implementation.

Reference Books:

1. Project-based software engineering: An Object-oriented approach, Evelyn Stiller, Cathie LeBlanc; Pearson Education
2. VisualModelling with Rational Rose 2002 and UML, Terry Quatrini; Pearson Education
3. UML2 Toolkit, Hans -Erik Eriksson, etc; Wiley
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**Scope:** Lab Experiments using Weka Tool and R programming on benchmark datasets.

1. Demonstration of preprocessing on some datasets eg. Student.aarf/ labor.aarf/Iris/loan/etc
2. Demonstration of Data Visualisation using Weka/ R programming language
3. Demonstration of attribute selection and dimensionality reduction techniques
4. Demonstration of Association Rule extraction on Market basket data using apriori/ FPAgorithms
5. Demonstration of Decision tree construction using j48/ID3 Algorithm and evaluate the model
6. Demonstration of Classification Process using Naive Bayes Algorithm and evaluate the model
7. Demonstration of Classification Process using K-nearest Neighbor classification Algorithm and evaluate the results
8. Demonstration of partitional Clustering using K-means Algorithm and evaluate the results
9. Demonstration of Clustering using simple K-mediods algorithm and evaluate the results
10. Demonstration of Clustering process using DBScan algorithm and evaluate the results.
11. Demonstration of Clustering rules process on any datasets using Birch Algorithm and evaluate the results
12. Demonstration of hierarchical Clustering using agglomerative / divisive approaches and evaluate the results
DETAILED SYLLABUS FOR M.TECH (CST) THIRD SEMESTER

MTCST31     ELECTIVE-V BIG DATA ANALYTICS

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

1. Getting Ready to Use R and Hadoop, Installing R, Installing R-Studio, Understanding the nature of R Language, Installing Hadoop, Understanding Hadoop features, Learning the HDFS and Map Reduce architecture, Understanding Hadoop subprojects.

2. Writing Hadoop Map Reduce Programs Understanding the basics of Map Reduce, Introducing Hadoop Map Reduce, Understanding the Hadoop Map Reduce fundamentals, Writing a Hadoop MapReduce example, Learning the different ways to write Hadoop Map Reduce in R.

3. Integrating R and Hadoop Introducing RHYPE, Installing RHYPE, Understanding the architecture of HIPE, Understanding RHYPE samples, Understanding the RHYPE function, Introducing RHadoop, Understanding the architecture of RHadoop, Understanding RHadoop examples, Understanding the RHadoop function reference


5. Learning Data Analytics with R and Hadoop Understanding the data analytics project life cycle, Understanding data analytics problems, Exploring web pages categorization, Computing the frequency of stock market change, Predicting the sale price of blue book for bulldozers—case study.


7. Importing and Exporting Data from Various DBs Learning about datafiles as database, Understanding MySQL, Understanding Excel, UnderstandingMongo DB, Understanding SQLite, Understanding PostgreSQL, Understanding Hive, Understanding HBase.

Text Book:
1. Big Data Analytics with R and Hadoop By Vignesh Prajapati,
2. Big Data Analytics By Venkat Ankam, Packt Publishing Ltd. (Open Source book available)

Reference Books:
2. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation
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3. Integrating internet services. XML and JSON. HTTP APIs for accessing popular Internet services (Facebook, Twitter, and others). Practical activities. IoT Application Development: Application Protocols MQTT, REST/HTTP, CoAP, MySQL

4. Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

5. Ubiquitous computing, applications of IOT, Virtualization of network resources and physical devices in IOT.

6. Internet of Things Standardization M2M Service Layer Standardization OGC Sensor Web for IoT

**TEXT BOOK**

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems author. MARINA RUGGIERI H, RIVER PUBLISHERS SERIES IN COMMUNICATIONS
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, success criteria

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 active queries

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 in ANN.

5. **Bayesian Approaches:** Basics of Bayes Theorem and Concept Learning, Expectation Maximization, Minimum Description Length Principle, Naive 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-based Reasoning

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, FOCL Algorithm.

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 for induction

1995 Text Books:

2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani & Jerome Friedman, Springer Verlag, 2001

Reference Books:

2. Neural Networks for Pattern Recognition, Chris Bishop, Oxford University Press,
MTCST32 OPEN ELECTIVE: GPS APPLICATIONS

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

UNIT-1:
Development of NAVSTAR GPS. GPS Satellite configuration- Space segment, Control segment, User segment.

UNIT-2:
GPS working principle, basic equations for finding user position, user position determination with least squares estimator.

UNIT-3:
Other Global Satellite Constellations, GLONASS, GALILEO. Comparison of 3 GNSS (GPS, GALILEO, GLONASS) in terms of constellation and services provided.

UNIT-4:
GPS Signal generation, Pseudorandom noise (PRN) code, C/A code, P code, Navigation data, Signal structure of GPS, signal power.

UNIT-5:
Coordinate Systems: Geoid, Ellipsoid, Coordinate Systems, Geodetic and Geocentric coordinate systems, ECEF coordinates, world geodetic 1984 system, Conversion between Cartesian and geodetic coordinate frame.

UNIT-6:
GPS Error sources, ionospheric effects on GPS signals and its mitigation methods.

UNIT-7:
Satellite based augmentation system-need for GPS augmentation, GPS Aided GEO Augmented System (GAGAN).

Textbook:

Reference Books:

2. Standard Form of LPP, Basic Feasible Solutions, Unrestricted Variables, Simplex Algorithm, Artificial Variables, Big M Method, Two Phase Simplex Method, Degeneracy, Alternative Optimal, Unbounded Solutions, Infeasible Solutions, Primal and Dual Problems and Their Relations, Dual Simplex Method.


TextBooks:


MTCST32 OPEN ELECTIVE
4G – 5G MOBILE COMMUNICATION NETWORKS

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

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

Unit-1: Introduction

Unit-2: Emerging Technologies for 4G

Unit 3: Multi-gigabit wireless networks
Next generation (5G) wireless technologies - Upper Gigahertz and Terahertz wireless communications: Millimeter wave networking - Directionality and beam forming - Mobility and signal blockage - IEEE 802.11ad (60 GHz WLAN) MAC and PHY overview - Visible light communication - High-speed networking using LEDs - IEEE 802.15.7 PHY and MAC overview - Sensing through visible light - Visible light indoor localization and positioning.

Unit 4: Indoor localization and RF sensing
Smartphone localization - WiFi fingerprinting - protocols and challenges - Non-WiFi localization - Device-free sensing with radio frequency - Mining wireless PHY channel state information - Device-free localization and indoor human tracking - Activity and gesture recognition through RF.

Unit 5: Low-power networking
Backscatter communication - Radio Frequency Identification (RFID) technology overview - Energy harvesting tags and applications - Internet-of-Things (IoT) - IoT protocol overview - CoAP and MQTT - IPv6 networking in low-power PANs (6LoWPAN)

Unit 6: Future mobile networks
Drone networking - Multi-UAV networks, architectures and civilian applications - Communication challenges and protocols for micro UAVs - Connected and autonomous cars - Wireless technologies for Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications - Automotive surrounding sensing with GHz and THz signals.

Unit 7: Instructional Activities
Survey minimum of four 5G wireless networks for wireless communication and carry out simulation of those networks.

Text Books:
References Books:

Hyperlinks:
1. https://www.amazon.in/4G-LTE-Advanced-Pro-Road-5G-ebook/dp/B01IUACTDM
3. https://www.theiet.org/resources/books/telecom/5gwire.cfm?
5. https://www.researchgate.net/publication/311896317_Ultra-reliable_communication_in_a_factory_environment_for_5G_wireless_networks_Link_level_and_deployment_study
IVSEMESTER

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| 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 & Title Page
2. Bonafide Certificate
3. Abstract
4. Table of Contents
5. List of Tables
6. List of Figures
7. List of Symbols, Abbreviations and Nomenclature
8. Chapters
9. Appendices
10. References

The tables and figures shall be introduced at appropriate places.

2. PAGE DIMENSION AND BINDING SPECIFICATIONS:
The dimension of the project report should be in A4 size. The project report should be bound using a 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. PREPARATION FORMAT:

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 academic designation.

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 Size 12.

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 Appendix 3.

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 this head.

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 this head.

3.7 List of Symbols, Abbreviations and Nomenclature – One and a half spacing should be 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 into several chapters and each chapter may be further divided into several divisions and sub-divisions.

• Each chapter should be given an appropriate title.
• Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.

• 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 they annotate.

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 central theme.

• 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 page also.

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 quoted above.

REFERENCES:


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.