**MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.)**

(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)

NAAC Accredited with A+ + Grade

# *Syllabi of*
# *Departmental Courses (DC) Courses*
# *B.Tech IV Semester*
# *(Computer Science and Engineering)*
# *Under Flexible Curriculum*

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Department of Computer Science and Engineering

# COMPUTER NETWORKS
# 2150411 (DC)

## 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.

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### Unit-I

**Introduction:** Computer Network, Types- LAN, MAN & WAN, Data transmission modes- Serial & Parallel, Simplex, Half duplex & full duplex, Synchronous & Asynchronous transmission, Transmission medium- Guided & Unguided, Cables- Twisted pair, Coaxial cable & Optical fiber, Networking devices-Repeaters, Hub, Switch, Bridge, Router, Gateway, Modem, Proxy Server, Wireless router, & Wireless Access Point (WAPs). Performance Criteria- Bandwidth, Throughput, Latency (Delay), Propagation Time, Transmission time & Queuing Time, Network Standardization- OSI Reference Model & TCP/IP Reference Mode.

### Unit-II

**Physical Layer:** Network topologies- Bus, Ring, Star Topology & Mesh, Switching- Circuit switching, Message switching & Packet switching, Multiplexing; FDM – Frequency division multiplexing, WDM – Wavelength division multiplexing & TDM – Time division multiplexing, Wireless transmission- Electromagnetic spectrum, Radio transmission & Microwave transmission.

### Unit-III

**Data Link Layer:** Introduction, Design issues, Services, Framing, Error control, Flow control, ARQ Strategies, Error Detection and correction, Parity bits, Cyclic Redundant Code (CRC), Hamming codes, MAC Sub Layer- The channel allocation problem, Pure ALOHA ,Slotted ALOHA, CSMA ,CSMA/CD,CSMA/CA,IEEE 802.3 frame format.

**Unit-IV**

**Network Layer& Transport Layer:** Introduction, Design issues, Services, Routing- Distance vector routing, Hierarchical routing , Link state routing, Shortest path algorithm- Dijkstra's Algorithm & Floyd–Warshall's Algorithm, Flooding, Congestion Control- Open Loop & Closed Loop Congestion Control, Leaky Bucket & Token bucket Algorithm. Connection Oriented & Connectionless Service, Port addressing basics.

**Unit-V**

**Presentation, Session& Application Layer:** Introduction, Design issues, Presentation layer- Translation, Encryption & Compression. Session Layer – Dialog Control, Synchronization. Application Layer- Remote login, File transfer & Electronic mail.

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## RECOMMENDED BOOKS


- Behrouz A. Forouzan "Data Communication and Networking", McGraw – Hill Publications.
- Andrew Tanenbaum – Computer Networks, PHI
- Peterson and Davie, "Computer Networks, A systems Approach", 5th ed., Elsevier, 2011.
- Ying-Dar Liu, Ren-Hwang, Fred Baker, "Computer Networks: An open Source Approach", McGraw – Hill, 2001.


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## COURSE OUTCOMES

After completion of the course students would be able to:

1. **Categorizing** the components of data communication system
2. **Illustrate** the different types of network topologies, protocols, networks devices, transmission media
3. **Evaluate** channel allocation, framing, Error and flow control techniques.
4. **Describe** the functions of Network Layer and Transport Layer functions.
5. **Elaborate** the functions offered by session, presentation, and application layer and their Implementation.

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# Optimization Techniques

## 2150412

## COURSE OBJECTIVES:

- Understand the role of optimization in engineering applications.
- Define optimization problems and emphasize the importance of clear problem statements.
- Categorize optimization problems based on their characteristics and constraints.
- Differentiate between global and local optima and their implications in optimization.
- Explore concepts related to optimal design and their significance in engineering.

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**Unit 1: Introduction to Optimization**

Overview of Optimization: Understanding the role of optimization in engineering applications. Problem Formulation: Defining optimization problems, emphasizing the importance of clear problem statements. Classification: Categorizing optimization problems based on their characteristics and constraints.

**Unit 2: Optimum Design**

Optimal Design Concepts: Exploring concepts related to optimal design and their significance in engineering. Global vs. Local Optima: Differentiating between global and local optima, and their implications in optimization. Optimality Criteria: Introduction to criteria used to evaluate optimality, ensuring a comprehensive understanding. Basic Calculus Review: Revisiting fundamental calculus concepts relevant to optimization problems. Global Optimality: Examining the concept of global optimality and its application in engineering scenarios.

**Unit 3: Linear Programming**

Introduction to linear programming (LP), Formulation of linear programming problems, Graphical method for solving two-variable LP problems, Matrix notation and operations, Vector spaces and linear independence

**Unit 4: Optimization Algorithms for Unconstrained and Constrained Optimization Problems**

The distinction between constrained and unconstrained optimization. Basics of Gradient Descent: Introduction to gradient-based optimization, Gradient Descent algorithm. Steepest Descent: Understanding the steepest descent method, Comparison with traditional gradient descent, Applications and limitations. Newton's Method: Second-order optimization with Newton's method, Hessian matrix and convergence analysis.

**Unit 5: Modern Methods of Optimization**

Genetic Algorithms: Introduction to genetic algorithms and their role in optimization. Simulated Annealing: Exploring the principles and applications of simulated annealing in optimization problems. Ant

Colony Optimization: Understanding the concepts and applications of ant colony optimization. Fuzzy Optimization Techniques: Introduction to fuzzy optimization techniques and their practical applications.

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**RECOMMENDED BOOKS:**

- Jorge Nocedal , Stephen J. Wright: Numerical Optimization.
- Andreas Antoniou, Wu-Sheng Lu: Practical_Optimizatopn
- Stephen Boyd, and Lieven Vandenberghe: Convex Optimization

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**COURSE OUTCOMES:**

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

1. **Describe** fundamental concepts of optimization, including its role in engineering applications.
2. **Describe** a clear understanding of the importance of formulating optimization problems.
3. **Apply** their knowledge by classifying optimization problems, formulating linear programming problems.
4. **Analyze** optimization algorithms such as gradient descent, steepest descent, Newton's method, and direct methods for constrained optimization.
5. **Differentiate** between global and local optima, evaluating optimality criteria.
6. **Evaluate** optimization methods, comparing their efficiency, limitations, and practical applications.

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# DATA MINING & WAREHOUSING

## 2150413

**COURSE OBJECTIVES:**

- To understand the value of data mining in solving real-world problems.
- To gain understanding of algorithms commonly used in data mining tools.
- To develop ability for applying data mining tools to real-world problems

**Unit-1:**

Unit - I Introduction: Motivation: Important, Data type for Data Mining: Relational Databases Data Ware-Houses. Transactional Databases, Advanced Database System and Its Applications, Data Mining Functionalities Concept/Class Description, Association Analysis Classification & Prediction, Cluster Analysis, Outliner Analysis Classification of Data Mining Systems, Major Issues in Data Mining

**Unit-2:**

Data Warehouse and OLTP Technology for Data Mining: Differences between Operational Database Systems & Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, Emerging Scenario of Pattern Warehousing System

**UNIT -3:**

Data Pre-processing: Data Cleaning, Data Integration and Transformation, Data Reduction Discretization and Concept Hierarchy Generation. Data Mining Primitives Languages and System Architectures, Concept Description, Characterization and Comparison Analytical Characterization.

**UNIT-4:**

Mining Association Rules in Large Databases: Association Rule Mining Market Basket Analysis, Basic Concepts, Mining Single Dimensional Boolean Association Rules from Transactional Databases: The Apriori Algorithm, Generating Association Rules from Frequent Items, Improving the Efficiency of Apriori, other Algorithms & their Comparison, Mining Multilevel Association Rules, Multidimensional Association Rules, Constraint Based Association Rule Mining.

**UNIT -5:**

Classification & Predication and Cluster Analysis: Issues Regarding Classification & Predication, Different Classification Methods, Predication, Cluster Analysis, Major Clustering Methods, Currently Available Tools, Case Study.

RECOMMENDED BOOKS

• Data Mining: Concepts and Techniques, Han and Kamber, Morgan Kaufmann Publications.

• Data Mining Techniques, A. K. Pujari, Universities Press Pvt. Ltd .

## COURSE OUTCOMES:

After completion of this course, the students would be able to:

1. **Classify** various databases systems and data models of data warehouse.
2. **Compare** various methods for storing and retrieving data from different data sources/repository.
3. **Apply** preprocessing techniques for construction of data warehouse.
4. **Analyze** data mining for knowledge discovery & prediction.
5. **Explain** data mining methods for identification of association for transactional databases.
6. **Develop** various classification and clustering algorithms for data using data mining.

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# THEORY OF COMPUTATION
# 2150414 (DC)

## COURSE OBJECTIVE

- To understand computability, decidability, and complexity through problem solving.
- To analyse and design abstract model of computation & formal languages
- To understand and conduct mathematical proofs for computation and algorithms.

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**Unit-I**

**Introduction to Theory of Computation:** Automata, Computability and Complexity, Alphabet, Symbol, String, and Formal Languages, Examples of automata machines, Finite Automata as a language acceptor and translator, Moore machines and Mealy machines, Composite Machine, Conversion from Mealy to Moore and vice versa.

**Unit-II**

**Types of Finite Automata:**Non Deterministic Finite Automata (NDFA), Deterministic finite automata machines, conversion of NDFA to DFA, minimization of automata machines, regular expression, Arden's theorem. Pumping lemma, applications, Closure properties of regular languages, 2 way DFA.

**Unit-III**

**Grammars:** Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, Rightmost and Leftmost derivations of Strings, ambiguity in grammar, simplification of context free grammar, killing null and unit productions, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar,. Chomsky Normal Form (CNF) and Greibach Normal Form (GNF).

**Unit-IV**

**Push down Automata:** Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack, Example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA.

**Unit-V**

**Turing Machine:** Techniques for construction. Universal Turing machine Multitape, multihead and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable languages, undecidable languages, Halting problem of Turing machine & the post correspondence problem (PCB).

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## RECOMMENDED BOOKS


- Introduction to Automata Theory Language & Computation, Hopcroft & Ullman, Narosa Publication.
- Element of the Theory Computation, Lewis & Christors,Pearson.
- Theory of Computation, Chandrasekhar & Mishra,PHI.
- Theory of Computation, Wood, Harper &Row.
- Introduction to Computing Theory, Daniel I-A Cohen,Wiley.


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## COURSE OUTCOMES

After completion of this course, the students would be able to:

1. **Describe** the basic concepts of switching and finite automata theory & languages.
2. **Compute** abstract models of computing and check their power to recognize the languages.
3. **Analyse** the grammar, its types, simplification and normal form.
4. **Design** mathematical models to prove properties of languages, grammars and automata.
5. **Apply** automata theory, languages and computation in engineering application.

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# ARTIFICIAL INTELLIGENCE
# 2150415

**Course Objectives:**

- To acquire knowledge on intelligent systems and agents.
- Formalization of knowledge, reasoning with, machine learning, Fuzzy Logic and Applications at a basic level.

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**Unit: 1**

Introduction: Need and Scope of Artificial Intelligence, History, Definition of Artificial Intelligence, Task and Objectives of Artificial Intelligence, Techniques of Artificial Intelligence. Artificial Intelligence Problems: Problems Definition, Problem Spaces and Production System. Characteristics of Production Systems, Types of Production System. Control Strategies, Example: water-jug, 8 – Puzzle, Cannibals & Missionaries problems.

**Unit: 2**

Agent: Introduction, Types of Agent, Searching techniques: Informed search and Uninformed search, Breadth search and Depth first search, Best First Search, Heuristic search. Heuristic estimation and evaluation, Hill climbing and their Problems.

**Unit: 3**

Knowledge Representation: Introduction, Definition and importance Of Knowledge, Approaches to knowledge Representation, Issues in Knowledge Representation, Procedural and Declarative Knowledge, Knowledge Representation Techniques: Logics, Prepositional Logic, Predicate Logic, Semantic networks.

**Unit: 4**

Learning Algorithms: Introduction of algorithms, characteristic of algorithm, Introduction of Machine Learning, Supervised learning, Unsupervised learning, Reinforcement learning.
Logical reasoning: Fuzzy Logic, operations of fuzzy logic. Forward Versus Backward Reasonings.
Artificial Intelligence in Mathematics: Statistical concept (Mean, mode, median, standard deviation), Bayes theorem.

**Unit: 5**

Applications of Artificial Intelligence: Emerging fields of Artificial Intelligence, Introduction of Data science, Natural Language Processing, Speech Recognition, Computer Vision and robotics, Smart Assistants, Game Playing, Puzzles. Expert System: Expert System Definition and its components.

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**RECOMMENDED BOOKS**


- Artificial Intelligence–Rich & Knight
- Artificial Intelligence and Expert System–Dan. W. Patterson
- Principles of Soft Computing, S. N. Sivanandam and S. N. Deepa , Wiley


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**COURSE OUTCOMES:**

After successful completion of the course, the learners would be able to:

1. **Explain** the basic concepts of Artificial Intelligence and its Applications.
2. **Classify and Compare** the various informed, uninformed and heuristic searching techniques.
3. **Classify and Compare** the various informed, uninformed and heuristic searching techniques.
4. **Illustrate** formal methods of Knowledge Representation.
5. **Evaluate** the various Machine Learning Algorithms for problem solving.
6. **Develop** a model based on Artificial Intelligence techniques.

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**PROGRAMMING LAB. (ROBOTICS AND AUTOMATION)**
**2150416(DLC)**

# COURSE OBJECTIVES

- To provide the fundamental concepts and principles of digital electronics and its components.
- To know about the importance of sensors and actuators in IOT.
- Practical exposure of robotics and automation using arduino, raspberry Pi, etc.
- Explore the fundamentals of robotics along with various robot navigation and localization techniques.

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## Unit -I

**Introduction to Digital Electronics**: Digital vs Analog Systems, Logic Gates and Truth Tables, Designing Combinational Circuits, Multiplexers and Demultiplexers, Half Adder and Full Adder, SR, JK, D, and T Flip-Flops, Registers and Counters.

## Unit- II

**Introduction to Arduino & IOT:** Setup the IDE, Arduino Software ,Arduino Libraries, Basic programming for Arduino, Analog input and analog output on Arduino Mega board using PWM ,Interfacing LED, push button and buzzer with Arduino ,Interfacing Arduino with LCD, Understanding IoT fundamentals, IOT Architecture and protocols, Understanding Rasberry Pi and Jetson nano.

## Unit -III

**Robotic Sensors & Actuators:** Overview of Sensors working , Analog and Digital Sensors, Interfacing of Temperature and Humidity, IR and Ultrasonic sensors, Motion Sensor, Lidar, Gyroscope, Magnetometer, Camera and Color sensor, Interfacing of Relay Switch and Servo Motor,DC Motor Control, Stepper Motor Control, Gear Motor, Kinematics of Robotic Arms,

Computer Vision in Robotic Arms, Object Recognition and Tracking

## Unit -IV

**Fundamentals of Robotics:** Types and Applications of Robots, Control Systems in Robotics, Kinematics and Dynamics, Robot Localization: Odometry-Based Localization, Beacon-Based Localization, Map-Based Localization, Grid-Based Localization, Robot Navigation: Path Planning, Local Navigation, Collision Avoidance, SLAM-Based Navigation.

## Unit-V

**Application of Industrial Automation:** Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Health and Safety Monitoring Smart Cards, Plant Automation, Real life examples of IIOT in Manufacturing Sector.

## RECOMMENDED BOOKS


- "Internet of Things (IoT): A Hands-On Approach" by Arshdeep Bahga and Vijay.
- “Raspberry Pi Cookbook” by Simon Monk.
- "Introduction to Autonomous Robots" by Nikolaus Correll
- "Robot Dynamics and Control" by Mark W. Spong
- "Industry 4.0: The Industrial Internet of Things" by Alasdair Gilchrist


### COURSE OUTCOMES

After completion of the course students would be able to:

1. **Implement** arduino programming code for different problems.
2. **Analyze** and understand fundamental of robotics.
3. **Explore** the integration of different sensor and actuators.

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