Centre for Artificial Intelligence

ANNEXURE-V

Syllabi
of all courses of
B. Tech. I Semester
Artificial Intelligence (AI)/ Information Technology (Artificial Intelligence and Robotics)/ Artificial Intelligence (AI) and Data Science/ Artificial Intelligence (AI) and Machine Learning
[under the MITS-DU]
under the flexible curriculum along with their COs
(Batch admitted in academic session 2025 – 26)

Centre for Artificial Intelligence

DIGITAL LOGIC DESIGN

(24251101/31251101/27251101/28251101)

COURSE OBJECTIVES

- To understand the fundamental operating components of Digital Computers.
- To learn various number systems, and boolean algebra employed in digital computers.
- To understand the concepts of counters, latches, and flip-flops.

Unit I Basic of Computer and Number System

Components of a Computer System: Introduction, Processor, Arithmetic and Logic Unit, Control Unit, System Bus, Computer Memory and its types; Introduction to Digital Electronics, Needs and Significance, Different Number Systems: Binary Numbers, Octal and Hexadecimal Numbers, Conversions, Complement, Signed Binary Numbers, Binary Arithmetic, Binary Codes.

Unit II Boolean Algebra

Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Boolean Relations, Logic Gates, De Morgan's Theorem, Karnaugh Maps and Simplifications.

Unit III Combinational and Sequential Logic

Combinational Circuits: Half Adder, Full Adder, Binary Adder-Subtractor, Binary Multiplier, Comparator, Decoders, Encoders, Multiplexers.

Sequential Circuits: Latches, Flip-Flops: RS Latches, Level Clocking, D Latches, Edge-triggered D Flip-flop, Edge-triggered JK Flip-flop, JK Master-slave Flip-flop; Registers, Shift Registers, Counters.

Unit IV Memory and Programmable Logic

Introduction to Memory, Memory Decoding, Programmable Devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field-Programmable Gate Array (FPGA).

Unit V Advanced Digital Design

Logic design for neural network inference, Systolic arrays for matrix multiplications. Secure Hardware Design: Logic-level countermeasures for hardware Trojans, Side-channel attack resistance. Classical-to-quantum interface circuits. High-speed serial interfaces (PCIe, USB4, DDR5).

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RECOMMENDED BOOKS

1. Digital Design, 6th Edition, M. Morris Mano, Michael D. Ciletti, ISBN-13: 9780134549897. (2018).
2. Fundamentals of logic design, Roth, C. H., Kinney, L. L., & John, E. B. (2004).
3. Digital Electronics: Principles, Devices and Applications, Anil K. Maini, Wiley,(2007).
4. Introduction to digital logic design, Hayes, J. P. Addison-Wesley Longman Publishing Co., Inc..(1993).

COURSE OUTCOMES

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

CO1 explain different number systems and boolean algebra principles.

CO2 evaluate various boolean expressions.

CO3 design combinational and sequential circuits.

CO4 interpret the functionality of memory devices and programmable logic devices.

CO5 create practical digital systems and identify their use in computing and embedded systems.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1	1		1		1	1	1	1	2	1
CO2	3	3	3	2	1		1		1	1	2	2	1	1
CO3	3	3	2	2	1	1			1	1	1	2		2
CO4	3	3	2	2	2	1	1		1	1	2	2	1	2
CO5	3	3	1	1	2	1	1	2	2	1	1	3	2	1

Centre for Artificial Intelligence

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE
(31251102)

COURSE OBJECTIVES

- To provide an overview of the fundamental concepts and techniques used in Artificial Intelligence.
- To develop an understanding of Artificial Intelligence methods related to knowledge representation, reasoning, and learning.

Unit I Introduction to Artificial Intelligence

Fundamentals of Artificial Intelligence: Definitions, Introduction, key concepts, Evolution, Terminology, Approaches and Goals. Ethical aspects of Artificial Intelligence. Relation between Artificial Intelligence, Machine Learning and Deep Learning. Intelligent Agents: Structure, Types and interaction with the environment.

Unit II Problem Solving

State space search; production systems, search space control, Uninformed and Informed Search: depth first search, breadth-first search. Heuristic Search: Best First Search, Hill Climbing. Game Playing: Minimax, alpha-beta pruning.

Unit III Knowledge Reasoning

Introduction to Knowledge representation, Building a Knowledge Base: propositional logic, first order logic and inferencing. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks.

Unit IV Learning in Artificial Intelligence

Definition, process, types - unsupervised and supervised learning. Regression, Classification, Bias-Variance trade-off, Overfitting-Underfitting, loss function, cross-validation

Unit V Applications of Artificial Intelligence

Healthcare: Diagnosis, treatment, and medical imaging; Finance: Fraud detection, algorithmic trading, and risk assessment; Transportation: Autonomous vehicles and traffic optimization; Customer service and chatbots; Education: Personalized learning and intelligent tutoring systems.

Centre for Artificial Intelligence

RECOMMENDED BOOKS

1. Artificial Intelligence, Patrick Henry Winston, Third Edition, Addison-Wesley Publishing Company, 2004.
2. Principles of Artificial Intelligence, Nils J. Nilsson, Illustrated Reprint Edition, Springer Heidelberg, 2014.
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson, 2016.
4. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivashankar B Nair, 3rd Edition, Tata McGraw Hill, 2011.
5. A first course in artificial intelligence, Khemani, Deepak, McGraw-Hill Education, 2014.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 demonstrate fundamental concepts of Artificial Intelligence.
CO2 evaluate the performance of heuristic and game tree search algorithms for optimized decision-making.
CO3 construct logical models using propositional and first-order logic to infer knowledge from given facts.
CO4 describe the various learning techniques of Artificial Intelligence and its application.
CO5 analyze problem-solving strategies to determine the most effective approach for artificial intelligence based search problems.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1	2	2	1	1	1	1	1	2	3	3
CO2	3	3	2	2	2	2	1	1	1	1	1	2	2	2
CO3	2	3	2	3	2	1	1	1	1	1	1	2	3	3
CO4	3	2	2	2	3	2	1	2	1	1	2	3	3	3
CO5	3	2	2	1	2	2	2	2	3	3	3	3	3	3

Centre for Artificial Intelligence

INTERNET AND WEB TECHNOLOGIES

(31251103/ 27251102/ 28251103)

COURSE OBJECTIVES

- To understand the fundamental concepts of the Internet and Web technologies.
- To learn about web development technologies.
- To gain hands-on experience in designing and implementing web applications.

Unit I Introduction to the Internet

Evolution of Internet: Usage, Impact; Significance, Applications, WWW, Search Engines, Webpages, Websites, URLs, Web Browsers, Web Servers, Web Crawlers, Web Hosting, Domain Names, and Types of Web Documents.

Unit II Internetworking Devices and Models

Introduction to computer networks and their types: Network Topologies, OSI and TCP/IP models, Functionality and Applications Network Devices: Hubs, Repeaters, Cables, Modems, Routers, Switches, Gateways and Firewalls and Access Points.

Unit III Network Address and Protocols

IP Addressing: Classless and Classful address, Structure and Format of IP Addresses, Subnetting, Supernetting; Public vs. Private IP Addresses, Routing, Network Protocols: HTTP, HTTPS, FTP, SMTP, DNS.

Unit IV HTML (Hypertext Markup Language)

Basic structure of an HTML document, Elements, tags, and attributes; HTML Text Formatting: Headings, paragraphs, and text formatting tags; Lists and Tables: Ordered and unordered lists, Creating and formatting tables; Forms and Inputs: Form elements and attributes, Input types and validation; HTML5 Advanced Features: Semantic elements, Multimedia; Introduction to Cascading Style Sheets (CSS) and XML.

Unit V Applications of Internet and Web Technology

Email and Messaging, Web-based email services, E-commerce: Types of e-commerce (B2B, B2C, C2C), Payment gateways and security; Social Media: Popular social media platforms, Impact on communication and marketing; Cloud Computing: Basics of cloud services (IaaS, PaaS, SaaS).

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RECOMMENDED BOOKS

1. Web Applications: Concepts and Real World Design, Knuckles, Wiley-India
2. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel. Pearson, Fifth edition.
3. Computer Networking: A Top-Down Approach by James F. Kurose and Keith W. Ross, Pearson Education Limited; 8th edition, 2021.
4. HTML and CSS: Design and Build Websites by Jon Duckett, Wiley, 2011.

COURSE OUTCOMES

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

CO1 describe the fundamental concepts of the internet and web technologies.

CO2 explain the functioning of Internet protocols and the structure of IP addressing

CO3 analyze the role and functionality of internetworking devices and their impact on network performance and security.

CO4 create web pages, incorporating multimedia elements and forms.

CO5 design and develop a comprehensive web application.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	1	1	3	3	1		1	3	1
CO2	3	3	3	3	1	1		3	3		1	1	3	2
CO3	3	3	3	3	3	3	2	3	2	3	3	3	2	3
CO4	3	3	3	3	3	2		3	3	1		2	3	1
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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PROBLEM SOLVING AND PROGRAMMING

(24251104/ 31251104/ 27251104/ 28251104)

COURSE OBJECTIVES

- To develop the understanding of algorithms, programming approaches and program documentation techniques.
- To design and implement programming solutions for problem solving.

Unit I

Introduction to Programming, Machine Level Languages, Assembly Level Languages, High Level Languages, Program Execution and Translation Process, Problem solving using Algorithms and Flowcharts. Introduction to Programming: Data Types, Constants, Keywords, Operators & Expressions, Precedence of operators and input/output functions.

Unit II

Control Statements and Decision Making: The goto statement, The if statement, The if- else statement, Nesting of if statements, The conditional expression, The switch statement, The while loop, The do…while loop, The for loop, The nesting of for loops, The break and continue statement.

Unit III

Arrays, Strings & Pointers: One dimensional Arrays, Passing Arrays to Functions, Multidimensional Arrays, Strings, Basics of Pointers & Addresses, Pointer to Pointer, Pointer to Array, Array of Pointers, Types of pointers, Pointer to Strings. Functions: Function Basics, Function Prototypes, Passing Parameter by value and by reference, Passing string to function, Passing array to function, Function returning address, Recursion.

Unit IV

Structures & Union: Pointer to Structure, Self-Referential Structures, Dynamic memory allocation by malloc/calloc function, Storage Classes. File Handling: Defining and Opening a file, Closing Files, Input/output Operations on Files, Predefined Streams, Error Handling during I/O Operations, Command Line Arguments.

Unit V

Basics of graphics libraries (SFML, SDL, OpenGL), Event-driven programming and game loops. Using C++ for performance-critical parts of ML/DL applications. Interfacing with system APIs (Linux syscalls, Windows API).

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RECOMMENDED BOOKS

1. The C Programming Language, by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall.
2. C++ How to Program, by H M Deitel and P J Deitel, Prentice Hall.
3. Programming in ANSI C, by E. Balagurusamy, Tata McGraw-Hill.
4. Schaum's Outline of Programming with C, by Byron Gottfried, McGraw-Hill.
5. The Complete Reference in C++, by Herbert Schildt, 5th Edition, McGraw-Hill.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 describe the basic principles of procedural programming and develop algorithms and flowchart for a given problem.

CO2 design solutions to computational problems using control statements.

CO3 create modular programs using arrays, strings, pointers, and functions.

CO4 apply structures, unions, dynamic memory allocation, and file handling concepts to build efficient data-driven programs.

CO5 develop interactive and high-performance applications.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	2		3	3	1	1	2	3	2
CO2	3	3	3	3	3	2		3	3	1		2	3	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	1	3	3	1	1	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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LINEAR ALGEBRA

(24251105/ 31251105/ 27251105/ 28251105)

COURSE OBJECTIVES

- To understand the concept Matrices and its applications
- To understand the various aspect of algebraic structures
- To explore vector space
- To perceive knowledge of linear transformation and their application

Unit I

Matrix, Rank of Matrix, Echelon form, Normal form of matrix, Solution of simultaneous equation by elementary transformation, Consistency of equation, Eigenvalues and Eigenvectors, Normalized eigenvector, Cayley Hamilton theorem and its application to finding inverse of matrix.

Unit II

Introduction of Groups and its properties, Sub-groups, Coset, Lagrange's theorem for finite groups, Ring and its properties, Field, Integral domain.

Unit III

Vector spaces over the field and its properties, sub-spaces, linear dependent vectors and linear independent vectors, linear combination of vectors, linear span of a set of vectors, basis and dimension of a vector space.

Unit IV

Linear transformation, Kernel and range space of linear transformation, Nullity and Rank, Singular and Non-Singular transformation, Matrix representation of a linear transformation.

Unit V

Inner product spaces, Properties of inner product space, Schwarz's inequality, Triangular inequality, Parallelogram Law, Orthogonality, Pythagoras theorem.

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RECOMMENDED BOOKS

1. S. Lipschutz and M. Lipson, Linear Algebra (4th Edition), Schaum's Outline series, Mc-Graw Hill.(2009).
2. S. Boyd and L. Vandenberghe, Introduction to Applied Linear Algebra Vectors, Matrices, and Least Squares, University Printing House, Cambridge CB2 8BS, United Kingdom One Liberty Plaza, 20thFloor,New York, NY10006, USA, (2018).
3. E.Kreyszig: Advance Engineering Mathematics, JohnWiley&Sons,10thEdition(2011).
4. R. K. Jain, S. R. K. Iyengar: Advance Engineering Mathematics, Narosa Publishing House Pvt. Ltd, 5th Edition(2016).

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 determine the solution of Matrix
CO2 find the analytical solution of algebraic structures
CO3 express the vector space
CO4 acquire the knowledge of Linear transformation
CO5 illustrate the concept of Inner product spaces

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	2	1	1	1	1	2	1	1	3	2
CO2	2	3	2	2	1	1	1	1	1	1	1	1	3	2
CO3	3	2	3	2	2	1	1	1	1	2	1	1	3	2
CO4	3	3	3	3	3	2	1	1	1	2	2	2	3	2
CO5	3	2	2	2	2	2	1	1	1	2	1	1	3	2

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UNIVERSAL HUMAN VALUES & PROFESSIONAL ETHICS (UHVPE)

(24251111/ 31251111/ 27251111/ 28251111)

COURSE OBJECTIVES

- Sensitization of students towards self, family (relationship), society and nature.
- Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Unit I

Introduction: Need, Basic Guidelines, Content and Process for Value Education: Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.

Unit II

Understanding Harmony in the Human Being: Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of 'I' with the Body.

Unit III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships), and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society.

Unit IV

Understanding Harmony in the Nature and Existence - existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Coexistence of mutually interacting units in all pervasive space, Holistic perception of harmony at all levels of existence.

Unit V

Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human

values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, Ability to identify and develop appropriate technologies and management patterns for above production systems. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers, At the level of society: as mutually enriching institutions and organizations.

Unit VI

Gender Sensitisation: Introduction to Sex, Gender & Culture, Introduction to Women Studies and Socialisation, including man-woman relationship, work distribution, A brief review of Feminism, Patriarchy, Feminist Studies, Feminist Ideologies. Women and Law Constitutional Provisions and Fundamental rights related to Women.

RECOMMENDED BOOKS AND REFERENCES

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. On Education - J Krishnamurthy
7. Siddhartha - Hermann Hesse
8. Old Path White Clouds - Thich Nhat Hanh
9. On Education - The Mother
10. Diaries of Anne Frank - Anne Frank
11. Life and Philosophy of Swami Vivekananda
12. Swami Vivekananda on Himself
13. Small is Beautiful - E. F Schumacher.
14. Slow is Beautiful - Cecile Andrews
15. Economy of Permanence - J C Kumarappa
16. Bharat Mein Angreji Raj - Pandit Sunderlal
17. Mahatma and the Rose
18. The Poet and the Charkha
19. Rediscovering India - by Dharampal
20. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
21. Swaraj by Arvind Kejriwal
22. India Wins Freedom - Maulana Abdul Kalam Azad
23. Ramakrishna ki jeevani - Romain Rolland (English)
24. Vivekananda - Romain Rolland (English)
25. Gandhi - Romain Rolland (English)
26. Autobiography of a Yogi – by Paramhansa Yogananda

27. Gandhi and Question of Science – Sahasrabudhe

COURSE OUTCOMES

After completion of the course students will be able:

CO1 to become more aware of their surroundings, society, social problems and their sustainable solutions.

CO2 to become sensitive to their commitment towards what they believe in (humane values. Humane relationships and humane society).

CO3 to apply what they have learnt to their own self in different day-to-day settings in real life.

CO4 to sustain human relationships and human nature in mind.

CO5 to have better critical ability.

CO6 to negotiate living in harmony with self and others.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3	3	2				2		
CO2						2	2	3	2	2		2		
CO3	2	2				2	1	2	1	2		3		
CO4						2	3	3	1			2		
CO5	2	3	2	2				2		2		3		
CO6						2	2	3	2	2		3		

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FOUNDATIONS OF ARTIFICIAL INTELLIGENCE AND ROBOTICS (24251102)

COURSE OBJECTIVES

- Introduce the fundamental concepts of Artificial Intelligence and Robotics.
- Develop an understanding of the ethical, societal, and safety considerations in the deployment of AI and robotic systems.

Unit I: Introduction to Artificial Intelligence

Fundamentals of Artificial Intelligence: Definitions, Introduction, key concepts, Evolution, Terminology, Approaches and Goals. Relation between Artificial Intelligence, Machine Learning and Deep Learning. Intelligent Agents: Structure, Types and interaction with the environment.

Unit II: Problem Solving

State space search; production systems, search space control, Uninformed and Informed Search: depth first search, breadth-first search. Heuristic Search: Best First Search, Hill Climbing. Game Playing: Minimax, alpha-beta pruning.

Unit III Basics of Robotics

Overview: Types of Robots, evolution, and Applications; Interplay between artificial intelligence and Robotics; Introduction to Robot Kinematics: Forward and Inverse Kinematics; Sensors in Robotics: Types (Proximity, Vision, LIDAR); Actuators: Motors and Controllers; Basics of Robot Control: Path Planning and Navigation; Introduction to Robot Operating System (ROS).

Unit IV Artificial intelligence for Robotics

Supervised and Unsupervised Learning; Introduction to Neural Networks; artificial intelligence Algorithms for Robotic Control: Reinforcement Learning, Path Planning Algorithms; Computer Vision in Robotics: Object Detection and Recognition; Sensor Fusion and Localization; Motion Planning for Autonomous Robots. Application of AI in Robotics.

Unit V Ethical, Societal, and Safety Considerations in AI and Robotics

Ethical Issues in AI and Robotics: Privacy, Bias, and Transparency; Societal Impacts: Job Displacement, Social Interactions; Safety and Reliability in Robotic Systems; Standards and Regulations for AI and Robotics.

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RECOMMENDED BOOKS

1. Industrial Robotics-Technology Programming and Applications by M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrey of McGraw-Hill Book and Company.
2. Introduction to Robotics by S. K. Saha of Tata McGraw-Hill Publishing Company Ltd.
3. Springer Handbook of Robotics, Siciliano, B. & Khatib, O., 2nd Edition, 2016, Springer.
4. Learning Robotics: From Fundamental Concepts to Advanced Programming, Asada, M. & Fukuda, T., 1st Edition, 2019, CRC Press.
5. Fundamentals of Mechatronics by Musa Jouaneh of Cengage Learning.
6. Artificial Intelligence: A Modern Approach, S. Russell and P. Norvig, Prentice Hall, Third Edition, 2009.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 describe the fundamentals of artificial intelligence and robotics
CO2 compare different problem solving methods that are used in artificial intelligence.
CO3 interpret different mechanisms involved in a robotic system.
CO4 recognize the vision based path planning algorithms in robotics.
CO5 illustrate ethical standards and applications of artificial intelligence and robotics.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	1		2	2	1			1	1	1
CO2	3	3	3	3	1	1	2	1		2	1	1	2	1
CO3	3	3	3	3	1	1	1		1	2	1	3	1	1
CO4	3	3	3	3		1	1	2		1	3	2	1	1
CO5	3	3	3	3	2	2			1	2	3	2	2	2

Centre for Artificial Intelligence
ELECTRONIC SYSTEMS
(24251103)

COURSE OBJECTIVES

- Introduce students to the fundamental concepts of electric circuits .
- Enable students to comprehend the operation of the basics of electrical & electronic components.
- To understand the construction and working principle of magnetic circuits and motors

Unit I

Basic Laws: ohm's law, kirchhoff's voltage and current laws, nodes-branches and loops, series elements and voltage division, parallel elements and current division, understanding the breadboards and its connections. fundamentals of AC circuit components.

Unit II

Semiconductor introduction: insulators, semiconductors and metals, mobility and conductivity, intrinsic and extrinsic semiconductors, charge carriers, carrier generation and recombination, carrier transport: diffusion and drift of carriers, Introduction to mobility and resistivity.

Unit III

Diode and its applications: PN Junction Diode- characteristics and analysis; types of diodes- zener diode, photodiodes, light emitting diode, varactor diode, photodetector, rectifiers: half wave rectifier, full wave rectifier, bridge rectifier, clippers, clamping operation, basic regulator using zener diode.

Unit IV

Bipolar junction transistor and its biasing: bipolar junction transistors: construction and characteristics of BJT, transistor configuration: common Base, common emitter, common collector configuration, transistor as a switch. Integrated circuits (ICs). Introduction to BJT Amplifiers.

Unit V Introduction to microcontroller based electronic systems: arduino and raspberry pi, Jetson Nano, TinyML and Real-Time AI on Microcontrollers, Neuromorphic Computing Systems, Quantum Electronic Systems for AI, Photonic Neural Networks and Optical Computing.

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RECOMMENDED BOOKS

1. Integrated Electronics by J. Millman and C.C. Halkias, McGraw Hill Education, India.
2. Electronics Devices and Circuit Theory by R. Boylestad and L. Nashelsky, Pearson India.
3. Electronics Devices and Circuits-II by U. A. Bakshi and A. P. Godse, Technical Publications.
4. Electronic principles by L. Malvino, Tata McGraw Hill Education.
5. Semiconductor Devices by K. Kano, Prentice Hall Publication.
6. Electronic Communication Systems by G. Kennedy, McGraw Hill Education, India.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 illustrate the fundamental behavior of circuit elements in DC circuits.
CO2 explain the working of semiconductor devices
CO3 analyze the functioning of electronic circuits.
CO4 explore the electrical machines and its principles.
CO5 integrate the electronic components and boards

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3		1	1	1	2	2		1	2	1
CO2	3	3	3	3	1				2	1	1		2	2
CO3	3	3	3	3		2	1	1	1		1	1	2	1
CO4	3	3	3	3	1			1	1	1	1		1	2
CO5	3	3	3	3	1	2	1	1	1		2		2	1

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FOUNDATIONS OF DATA SCIENCE
(27251102)

COURSE OBJECTIVES

- To understand the importance of data pre-processing, exploratory data analysis and other related techniques used in data sciences.
- To perform statistical analysis and extract useful information from the data.

Unit I

Introduction to Data Science: Benefits, uses and facets of data, Data Science Process: overview, retrieving data, Data preparation, Exploratory Data analysis, Basic Statistical descriptions of Data.

Unit II

Describing Data: Types of Data, Numeric, Text, Images, structured data, unstructured data types of Variables, Describing Data with Tables and Graphs, Describing Data with Averages, Describing Variability, Normal Distributions and Standard (z) Scores.

Unit III

Sampling and Estimation: Introduction, Population Parameter & Sample Statistic, Sampling, Probabilistic Sampling, Non-Probability Sampling, Sampling Distribution, Central Limit Theorem, Sample Size Estimation for Mean of the Population, Estimation of Population, Parameters, Method of Moments, Estimation of Parameters Using Maximum Likelihood Estimation.

Unit IV

Data Engineering: Data pre-processing, Data cleaning, Data transformation, Data Integration, Feature Engineering, Feature Extraction, Feature Selection, Feature scaling, Data reduction, Data mining concepts.

Unit V

Data Science Tools, Ethics and Industry Use Cases: IDEs for data science; Introduction to Scikit Learn, numpy, matplotlib, pandas libraries; Data Privacy and Security, Ethical Principles in Data uses, Industry use cases such as Retail, Finance, Healthcare, Manufacturing, Telecommunication, Logistics and supply chain, Transportation, Entertainment and media, Agriculture etc.

Centre for Artificial Intelligence

RECOMMENDED BOOKS

1. Doing Data Science: Straight Talk from the Frontline, by Rachel Schutt and Cathy O'Neil, O'REILLY, ISBN:978-1-449-35865-5, 1st edition, 2013.
2. Data Science from Scratch: First Principles with Python by Joel Grus, O'Reilly Media ISBN: 978-1491901427, 1st Edition, 2015.
3. The Data Science Design Manual, Steven S. Skiena, ISBN: 978-3319554433, Springer 2017.
4. Introduction to Statistical Learning by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Springer, ISBN: 978-1461471370, 2013
5. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett, O'Reilly Media ISBN-13: 978-1449361327, 2018

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 define the basic operations and applications related to various kinds of data.

CO2 describe various types of data and identify appropriate describing methodology for each.

CO3 implement mathematical sampling and estimation techniques on data for information extraction.

CO4 analyze feature engineering concepts for different applications.

CO5 illustrate data science tools, techniques and ethical aspects.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	1	1		1				3	1	3	3	2
CO2	3	3	3	2		2	1		2	2	2	3	2	3
CO3	3	3	2	3	3	1				1	2	3	2	3
CO4	3	1	1	1		1	2			1	1	3	2	2
CO5	3	3	3	3	3	2		3	2	3	2	3	3	3

Centre for Artificial Intelligence

FOUNDATIONS OF MACHINE LEARNING
(28251102)

COURSE OBJECTIVES

- To provide the fundamental knowledge of Artificial Intelligence and Machine Learning.
- To understand the basic working of techniques used in machine learning.
- To investigate applications of machine learning techniques in the real world.

Unit I

Introduction to Artificial Intelligence, History of Artificial Intelligence, Artificial Intelligence Problem, Approaches, Goals, Purpose, Scope, Terminology, Industrialization and its Impact, Evolution of Industry, Relation between Artificial Intelligence, Machine Learning, Deep Learning.

Unit II

Conventional Programming Vs Machine Learning, Data/Information/Knowledge, Type of Data: Structure, Non-Structure, Semi Structure, Data Types: Categorical/Nominal/Ordinal, Categorical and Continuous Data, Skewness and Correlation, Data Types Conversion, Model, Algorithm, Model Development Life Cycle, Learning, Training, Testing, Validation, Importance of Data.

Unit III

Introduction to Machine Learning: Basic Concepts of Machine Learning, Types of Learning: Supervised, Unsupervised and Reinforcement Learning, Design and Analysis of Machine Learning Experiments: Guidelines for machine learning experiments, Factors, Response, and Strategy of experimentation, Regression Vs Classification.

Unit IV

Supervised Learning: Linear and Logistic Regression, Linear models for classification, Sigmoid, Logistic regressions with examples. Unsupervised Learning: Clustering, Common distance measures, Hierarchical algorithms, partitioning algorithms, k-means; Cross-Validation and Resampling methods, measuring classifier performance.

Unit V

Machine Learning in Real World: Speech Processing, Natural Language Processing, Planning, manufacturing industry, logistic industry, Retail industry. Defense, Cyber Security, Agriculture, E-commerce, Finance, Smart Devices.

Centre for Artificial Intelligence

RECOMMENDED BOOKS

1. Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig, Prentice Hall Fourth Edition May 2022.
2. Artificial Intelligence: Elaine Rich, Kevin Knight, 2010, Tata McGraw-Hill Education Pvt. Ltd.
3. Foundations_of_Machine_Learning: Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar MIT Press, Second Edition, 2018.
4. Pattern Recognition and Machine Learning, Christopher M. Bishop
5. Introduction to Machine Learning using Python: Sarah Guido

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 define basic concepts of Artificial Intelligence.

CO2 identify different types of data and appropriate conversion methods for each.

CO3 explain the concepts of machine learning.

CO4 contrast between Supervised and Unsupervised Machine Learning approaches.

CO5 analyze the real world problems and applications of artificial intelligence and machine learning

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	1	1	3	3	1		1	3	1
CO2	3	3	1	3	1	1		3	3		1	1	3	2
CO3	3	3	3	3	3	3		3	3	1		2	3	2
CO4	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Centre for Artificial Intelligence

LANGUAGE LAB

(31251110/ 24251110/ 27251110/ 28251110)

COURSE OBJECTIVES

- The course intends to build the required communication skills of the students to communicate effectively in real-life situations like starting a talk and be comfortable using English language.
- It aims at teaching students to appreciate English language through the study of scientific, creative, and academic text.
- The course is designed to acquaint students with structure of English language used in literature, functional varieties, figurative language, and verbal concomitance.
- The students are expected to enrich their knowledge of language, culture, and ethics through this course.

Unit I

Communication: Approaches, Elements, Verbal and Nonverbal Communication; Barriers to Communication; Johari Communication Window.

Unit II

Listening: Factors Affecting Listening and Improving Listening.

Unit III

Speaking: Public Speaking & Delivering Presentation.

Unit IV

Reading: Reading Passages & Comprehension: Steps and Methods.

Unit V

Writing: Essentials of good writing; Drafting CV/biodata/Résumé.

Language Laboratory:

- The objective of the language lab is to expose students to a variety of listening and speaking drills. This would especially benefit students who are deficient in English and it also aims at confidence building for interviews and competitive examinations. The Lab is to cover the following syllabus.
    a. Communication lab exercises as specified in Lab Manual
    b. Listening skills (using Marc Hancock, CUP).
    c. Speaking skills
    d. Oral presentation.

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RECOMMENDED BOOKS

1. Understanding Human Communication, By Ronald Alderman by OUP.
2. Communication Skills for Engineers, Pearson Education.
3. Practical English Grammar by Thomson Martinet, Oxford University Press.
4. A Handbook of Language Laboratory by P Sreekumar, Cambridge University Press.

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 speak clearly effectively and appropriately in a public forum to a variety of audiences and purposes.

CO2 prepare oral dialogues and arguments within the engineering profession effectively.

CO3 demonstrate knowledge and comprehension of major text and traditions in language as well as its social, cultural, and historical context.

CO4 read a variety of Text analytically to demonstrate in writing and/or speech the interpretation of texts.

CO5 interpret text written in english assessing the results in written and oral arguments using appropriate material for support.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						1	1	1	3	3	1	2	1	1
CO2	3	1				1	1	1	3	3	1	2	1	1
CO3			3			3	3	1	2	2		2	1	1
CO4						1	1	1	2	3	1	2	1	1
CO5						1	1	1	2	3	1	2	1	1

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA
Deemed University
(Declared under Distinct Category by Ministry of Education, Government of India)
NAAC ACCREDITED WITH A++ GRADE

Centre for Artificial Intelligence

ANNEXURE-VI

Experiment list/ Lab manual for all the Laboratory Courses and Micro Project-I to be offered in B. Tech. I Semester [Artificial Intelligence (AI)/ Information Technology (Artificial Intelligence and Robotics)/ Artificial Intelligence (AI) and Data Science/ Artificial Intelligence (AI) and Machine Learning] under the flexible curriculum

(Batch admitted in academic session 2025 – 26)

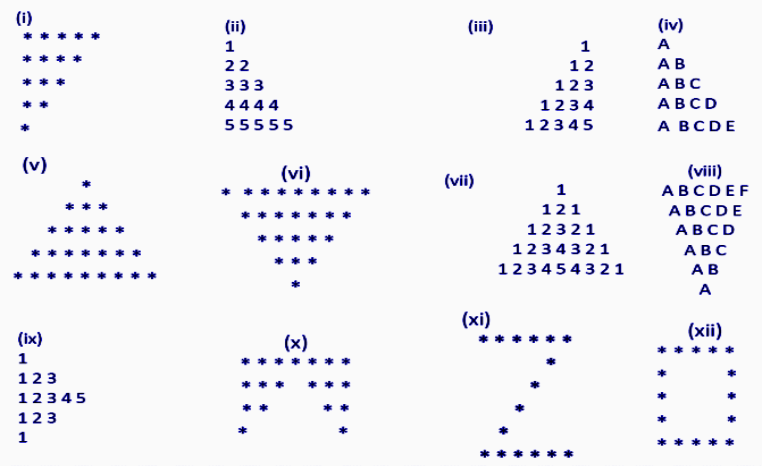
Centre for Artificial Intelligence

PROBLEM SOLVING AND PROGRAMMING LAB

(24251106/ 31251106/ 27251106/ 28251106)

List of Programs

1. Implementation of basic arithmetic operations on two numbers entered by the user and display the results.
2. Calculate and display the volume of a cylinder by taking height and radius as input from the user.
3. Realize the below mentioned expressions and display the values of dependent variables. The values of independent variables should be entered by the user:
    a. V = u + at
    b. S = ut+1/2at^2
    c. T=2*a+√b+9c
4. Create a program which takes name, roll no. and marks, obtained by a student in 5 subjects of 100 marks each, from the user and display the name, roll no. and percentage score secured.
5. Swap values of two variables with and without using the third variable.
6. Write a program to illustrate the use of unary prefix and postfix increment and decrement operators.
7. Find the largest of three numbers, entered by the user, using ternary operators.
8. Calculate the roots of quadratic equations, by taking the coefficients of the quadratic equation from the user as input.
9. Create a program which checks whether an integer entered by the user is prime or not.
10. Create a program which computes the SGPA of a student, in a semester, as per MITS norms.
11. Create a program which checks whether a year entered by the user is a leap year or not.
12. Calculate the sum of digits of an integer, entered by the user, using a for loop.
13. Create a separate program to display the following patterns using for loop:



14. Calculate factorial of a number using recursion.
15. Write a program which adds two matrices of the same order, entered by the user.
16. Perform addition and subtraction of two complex numbers, entered by the user; use structure data-type to represent the given complex numbers.
17. Write a program which copies the contents of one text file into another file, using various file handling operations available in C++.

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COURSE OUTCOMES

After completion of the course students will be able to:

CO1 apply basic programming concepts

CO2 illustrate the concepts of procedural programming

CO3 debug programs for error handling.

CO4 apply file handling concepts in programs for file manipulations.

CO5 design suitable programming solutions using procedural paradigms for real world problems.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	1	1	3	3	1		1	3	1
CO2	3	3	3	3	3	2		3	3	1		2	3	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	2	1	3	3	1	1	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Centre for Artificial Intelligence

INTERNET AND WEB TECHNOLOGIES LAB

(31251107/ 27251107/ 28251107)

List of Programs

1. Design a network with two PCs connected through a switch, assign appropriate IP addresses, and ensure successful communication.
2. Create a network topology that includes two subnets connected by a router. Assign IP addresses and verify connectivity between devices.
3. Construct a network with a server configured to provide FTP services. Assign IP addresses and allow PCs to upload and download files via FTP.
4. Design a network with an SMTP server to handle email communication. Assign IP addresses, configure email clients on PCs, and send test emails.
5. Create a network with a DNS server that resolves domain names for multiple devices. Ensure that PCs can access each other and external services using domain names instead of IP addresses.
6. Develop a network that integrates both SMTP and FTP services on a single server. Configure the PCs to access email services and file transfers.
7. Formulate a network topology where the DNS server resolves the domain name of an FTP server, allowing PCs to access it using the domain name instead of the IP address.
8. Design a simple HTML document with a proper structure, including DOCTYPE declaration, html, head, and body elements.
9. Apply text formatting tags to enhance the appearance of text in an HTML document.
10. Create a web page that includes both ordered and unordered lists, as well as a formatted table.
11. Design a form in HTML that includes different input types, such as text, email, password, radio buttons, checkboxes, and a submit button.
12. Integrate multimedia elements like audio, video, and images into an HTML document.
13. Design a responsive web page using CSS media queries to adapt the layout for different screen sizes.

NOTE: ***Networking experiment to be performed on CISCO Packet Tracer.***

COURSE OUTCOMES

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

CO1 design network topologies with IP addressing and device connectivity.

CO2 develop networks integrating SMTP and FTP services.

CO3 construct networks with FTP, SMTP, and DNS configurations.

CO4 create structured and responsive web pages using HTML and CSS.

CO5 formulate network solutions using DNS and FTP integration.

CO6 design suitable websites for appropriate catering of web users needs related to real-world problems.

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CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	1	1	3	3	1		1	3	1
CO2	3	3	3	3	1	1		3	2		1	1	3	2
CO3	3	3	3	3	3	2		3	3	1		2	3	2
CO4	3	3	2	3	3	3		3	3	3	3	3	2	3
CO5	3	3	3	3	3	2	1	3	3	1	1	2	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Centre for Artificial Intelligence

ELECTRONIC SYSTEMS LAB

(24251107)

List of Experiments

1. Familiarization of electronic components and measure and types of resistor.
2. To determine energy, value stored in capacitor and familiar with inductor
3. To measure and confirm ohm's law and explain for resistance in series and parallel.
4. To determine the V-I characteristics of P-N junction diodes its static and dynamic resistance.
5. To analyze the characteristics of zener diodes and hence, calculate the dynamic resistance.
6. To study voltage regulator circuits using zener diodes.
7. To verify the waveform of a half wave rectifier.
8. To explain and verify the center tapped and bridge full wave rectifier.
9. To study and plot the input and output characteristics of common emitter
10. To analyze and plot the input and output characteristics of a common base .

COURSE OUTCOMES

After completion of the course students will be able to:

CO1 inspect electronics circuits.

CO2 test the working of different electronic circuits.

CO3 analyzes the BJT in various electronic circuits.

CO4 determine and analyze the V-I characteristics of a P-N junction diode.

CO5 analyze the characteristics of a zener diode

CO6 Verify and compare the waveforms of half wave and full wave rectifiers.

CO-PO Mapping Matrix														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	1	1	3	3	1		1	3	1
CO2	3	3	1	3	1	1		3	3		1	1	3	2
CO3	3	3	3	3	3	3		3	3	1		2	3	2
CO4	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	1	3	3	1	1	2	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Centre for Artificial Intelligence
Micro Project-I
(24251109)

List of Projects

1. Build a two-player console-based Tic-Tac-Toe game where players take turns marking a 3x3 grid.
2. Develop an address book application to store and manage contacts' names, phone numbers, and addresses.
3. Create a program to manage student records, including information like name, ID, and grades. Users can add, update, and view student data.
4. Create a simple banking system that allows users to open accounts, deposit and withdraw money, and check their account balances.
5. Design a Library Management System using C++ to manage books, students, and borrowing records using structures and file I/O.
6. Design a Student Report Card Generator which Collects and stores marks, calculates grades, and generates reports using functions and structures.
7. Create an Inventory Management System which allows product listing, quantity update, and order tracking via a C++ console interface.
8. Design a C++ based Quiz Management System using procedural logic, menus, and score evaluation.
9. Design and analysis of a Zener Diode-based voltage regulator circuit.
10. Design and analyze transistors as a switch.
11. Verification of ohm’s law and analysis of resistive circuits: series and parallel configurations.
12. Designing a series circuit using breadboard and connecting wires.
13. Measure the various circuit components using Multimeter.
14. Designing a parallel circuit using a breadboard.
15. Perform the circuit analysis.
16. Design a Smart LED Intensity Controller that uses LDR and op-amp to automatically control brightness based on ambient light.
17. Design a Temperature-Based Fan Speed Control that uses LM35 temperature sensor with op-amp comparator and triac to vary fan speed.
18. Designing the resistor and led circuit using a breadboard.
19. Design a Sound-Activated LED Lights (Clap Switch) containing Audio sensor + flip-flop logic to toggle lighting.
20. Create a Traffic Light Controller with Sequential logic using timers and counters (or implemented on 8051/Arduino).

Centre for Artificial Intelligence
Micro Project-I
(31251109/ 27251109/ 28251109)

List of Projects

1. Build a two-player console-based Tic-Tac-Toe game where players take turns marking a 3x3 grid.
2. Develop an address book application to store and manage contacts' names, phone numbers, and addresses.
3. Create a program to manage student records, including information like name, ID, and grades. Users can add, update, and view student data.
4. Create a simple banking system that allows users to open accounts, deposit and withdraw money, and check their account balances.
5. Design a Library Management System using C++ to manage books, students, and borrowing records using structures and file I/O.
6. Design a Student Report Card Generator which Collects and stores marks, calculates grades, and generates reports using functions and structures.
7. Create an Inventory Management System which allows product listing, quantity update, and order tracking via a C++ console interface.
8. Design a C++ based Quiz Management System using procedural logic, menus, and score evaluation.
9. A multi-page Static University Website for showcasing a fictional college with events, contact, and gallery pages.
10. Create an Online Photo Gallery using HTML-based image grid with clickable previews and captions.
11. Design an educational website using HTML5 and CSS that includes interactive multimedia elements such as video and audio clips. The website should be responsive and designed to provide an engaging user experience.
12. Design a personal profile page with basic information, a profile picture, and social media links.
13. Create an Online Resume Builder using HTML/CSS frontend that takes user input and dynamically generates a resume layout.
14. Design a web portal for employee management.
15. Create a platform combining a responsive web interface with FTP for file management, SMTP for email notifications, and DNS for domain resolution.
16. Implement a network that includes multiple subnets connected by routers, with integrated SMTP, FTP, and DNS services. Ensure that the network supports seamless communication, file transfers, and domain name resolution across all devices.
17. Create a Student Management with Web Reporting using C++ backend to store student data, generate HTML report cards for browser viewing.
18. Design a Local File Search Engine with Web UI where C++ program scans local files, and results are displayed using an HTML-based interface.
19. Create an online voting system in which C++ handles voting logic and data; HTML used to present results and login options.
20. Design an E-commerce Simulation System in which C++ backend manages product info, stock, and orders; HTML used for user-facing catalog and invoice reports.