ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES: RAJAMPET
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

R23

III YEAR COURSE STRUCTURE

I Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1.	PCC	23A0451T	Analog and Digital IC Applications	3	0	0	3
2.	PCC	23A0452T	Microprocessors and Microcontrollers	3	0	0	3
3.	PCC	23A0453T	Antennas & Wave Propagation	3	0	0	3
4.	PCC	23A0554T	Introduction to Quantum Technologies and Applications	3	0	0	3
5.	PEC-I	23A045AT	Computer Architecture & Organization	3	0	0	3
		23A045BT	Information theory and coding				
		23A045CT	Detection and Estimation Theory				
6.	OEC-I		**Open Elective-I**	3	0	0	3
7.	PCC	23A0451L	Analog & Digital IC Applications Lab	0	0	3	1.5
8.	PCC	23A0452L	Microprocessors and Microcontrollers Lab	0	0	3	1.5
9.	SEC	23A0453L	VHDL Programming	0	1	2	2
10.	SEC	23A0454L	Tinkering Lab for Electronic Engineers	0	0	2	1
11.	INTERN	23A0459I	Evaluation of Community Service Internship	-	-	-	2
			Total	**18**	**1**	**10**	**26**

Open Elective – I

S.No.	Code	Title	Offered by the Dept
1.	23A015DT	Green Buildings	CIVIL
2.	23A015ET	Construction Technology and Management	
3.	23A025ET	Electrical Safety Practices and Standards	EEE
4.	23A035FT	Sustainable Energy Technologies	ME
5.	23A055ET	Java Programming	CSE& Allied/IT
6.	23A055FT	Fundamentals of Artificial Intelligence	
7.	23A055GT	Quantum Technologies and Applications	
8.	23AHS51T	Mathematics for Machine Learning and AI	Mathematics
9.	23AHS52T	Materials Characterization Techniques	Physics
10.	23AHS53T	Chemistry of Energy Systems	Chemistry
11.	23AHS54T	English for Competitive Examinations	Humanities
12.	23AHS56T	Entrepreneurship and New Venture Creation	

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Title of the Course: ANALOG AND DIGITAL IC APPLICATIONS
Category: PCC
Couse Code: 23A0451T
Branch/es: ECE
Year: III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1. Introducing the classification of Integrated Circuits, internal blocks and characteristics of Op-Amp.
2. To analyze linear and non-linear applications of Op-Amp.
3. To gain knowledge on active filters, timers and phased locked loops.
4. To understand the working of Voltage Regulators and Converters.
5. To study different types of Digital ICs and their applications.

Course Outcomes:

At the end of the course, the student will be able to

1. Comprehend the classification of IC's, internal blocks and characteristics of Op-Amp.
2. Analyze linear and non-linear applications of Op-Amp.
3. Gain the knowledge on active filters, analyze the timers and phased locked loops.
4. Comprehend the working of Voltage Regulators and Converters.
5. Comprehend different types of Digital ICs and their applications.

Unit 1 ICs and OP- AMPS 10

Integrated Circuits and Operational Amplifier: Introduction, Classification of IC's, IC chip size and circuit complexity, basic information of Op-Amp IC741 and its features, the ideal Operational amplifier, Op-Amp internal circuit, Op-Amp characteristics - DC and AC, Features of 741 Op-Amp.

Unit 2 Applications of OP- AMP 15

Linear Applications of Op-Amp: Inverting, non-inverting, Differential amplifiers, adder, subtractor, Instrumentation amplifier, AC amplifier, V to I and I to V converters, Integrator and differentiator.

Non-Linear Applications of Op-Amp: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger.

Active Filters: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters.

Unit 3 Timer and Converters 15

Timer: Introduction to IC 555 timer, description of functional diagram, monostable and Astable operations and applications, Schmitt trigger.

D to A and A to D Converters: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

Unit 4 Digital ICs **12**

CMOS Logic: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic.

Combinational Logic IC's: Code Converters, Decoders, Priority Encoders, Multiplexers, Demultiplexers, Parallel Binary Adder/ Subtractor, Magnitude Comparators.

Unit 5 Sequential Logic IC's **10**

Sequential Logic IC's: All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers.

Prescribed Textbooks:

1. D. Roy Choudhury, Shail B. Jain, —Linear Integrated Circuit‖, 4th edition (2012), New Age International Pvt.Ltd., New Delhi, India.
2. Floyd, Jain, Digital Fundamentals, 8th edition (2009), Pearson Education, New Delhi.

Reference Books:

1. Ramakant A. Gayakwad, OP-AMP and Linear Integrated Circuits, 4th edition (2012), Prentice Hall / Pearson Education, New Delhi.
2. Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi.
3. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of	Conduct investigations	Modern tool	Engineering and society	Ethics	Individual and team work	Communication	Project management	Life-long learning	**PSO1**	**PSO2**
23A0451T. 1	3	3	3	3	-	-	-	-	-	-	-	2	-
23A0451T. 2	3	3	3	3	-	-	-	-	-	-	-	2	-
23A0451T. 3	3	3	3	3	-	-	-	-	-	-	-	2	-
23A0451T. 4	3	3	3	3	-	-	-	-	-	-	-	2	-
23A0451T. 5	3	3	3	3	-	-	-	-	-	-	-	2	-

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Title of the Course: MICROPROCESSORS AND MICROCONTROLLERS
Category: PCC
Couse Code: 23A0452T
Branch/es: ECE
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1 To learn the fundamental architectural concepts of Microprocessors.
2 To gain knowledge about assembly language programming concepts.
3 To get familiar with the 8086 interfacing.
4 To understand the fundamentals of the 8051Microcontroller.
5 To learn interfacing with the 8051 Microcontroller.

Course Outcomes:

At the end of the course, the student will be able to

1 Learn the fundamental architectural concepts of microprocessors. (L2)
2 Write the assembly language programs. (L6).
3 Interface various sensors, display devices and other ICs with 8086 and comprehend the concepts of MSP 430 (L3).
4 Comprehend the fundamentals of the 8051 Microcontroller. (L2).
5 Interface input and output devices with 8051 Microcontroller. (L6).

Unit 1 8086 Architecture **10**

Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

Unit 2 8086 Programming **13**

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, and assembly language program development tools.

Unit 3 8086 Interfacing **14**

Semiconductor memories (RAM, ROM) - Intel 8255 Programmable Peripheral Interface, interfacing switches and LEDs, seven segment displays, Stepper motor - A/D and D/A converter - Intel 8251 USART architecture and interfacing - Need of DMA.
Features and architecture of MSP 430 (Mixed Signal Processor).

Unit 4 Microcontroller **10**

Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

Unit 5 Interfacing Microcontroller **12**

Programming 8051 Timers - Serial Port Programming - Interrupts – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors. 4

Prescribed Textbooks:

1 K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017

2. Kenneth J. Ayala, The 8051Microcontroller, 3rdedition, Cengage Learning,2004.

Reference Books:

1 Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013.

2. RajKamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

3. Microprocessors and Interfacing–Programming and Hardware by Douglas V Hall SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition,1994.

Online Learning Resources:

4. https://nptel.ac.in/courses/108/105/108105102/
5. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of	Conduct investigations	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management	Life-long learning	PSO1	PSO2
23A0452T. 1	2	1	1	1	-	-	1	-	-	-	1	-	-
23A0452T. 2	3	3	3	3	3	-	1	2	2	-	3	3	-
23A0452T. 3	3	2	1	1	-	-	1	-	-	-	1	-	-
23A0452T. 4	2	1	1	1	-	-	1	-	-	-	1	-	-
23A0452T. 5	3	3	3	3	3	-	1	2	2	-	3	3	-

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Title of the Course: ANTENNAS AND WAVE PROPAGATION
Category: PCC
Couse Code: 23A0453T
Branch/es: ECE
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1 To learn the antennas basic terminology, radiation mechanism of antenna.
2 Comprehend different techniques involved in the design of antenna arrays.
3 To gain comprehensive knowledge on HF, VHF & UHF antennas, their operation and applications
4 Analyze the working and applications of Microwave antennas.
5 To study the various types of radio wave propagation methods.

Course Outcomes:

At the end of the course, the student will be able to

1 comprehend the basic antennas terminology and radiation mechanism of antennas.
2 Analyze different techniques involved in the design of antenna arrays.
3 Gain knowledge on VHF and UHF antennas, their operation and applications.
4 Design and analyze the working and applications of Microwave antennas.
5 comprehend about the types of wave propagation.

Unit 1 Antenna Basics **12**

Definition of antenna, Antenna Parameters - Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Aperture Efficiency, Effective Height and length, Antenna Theorems (Reciprocity Theorem). Half wave Dipole – Current Distributions, Field Components, Radiated power, Radiation Resistance, Beam width, Illustrative problems.

Unit 2 Antenna Arrays **12**

Point sources - Definition, Patterns, arrays of 2 Isotropic sources- Different cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison, Binomial Arrays.

Unit 3 HF, VHF and UHF Antennas **10**

Loop Antennas - Introduction, Small Loop, Comparison of far fields of small loop and short dipole, Radiation Resistances and Directives of small and large loops (Qualitative Treatment), Arrays with Parasitic Elements - Yagi - Uda Arrays, Folded Dipoles & their characteristics. Helical Antennas-Helical Geometry, Helix modes, Horn Antennas- Types, Fermat ‘s Principle, Optimum Horns.

Unit 4 Microwave Antennas **10**

Microwave Antennas: Microstrip Antennas- Introduction, features, advantages and limitations, Rectangular patch antennas- Geometry and parameters, characteristics of Micro strip antennas. Reflector antennas - Introduction, Flat sheet and corner reflectors, parabola reflectors- geometry, pattern characteristics, Lens Antennas - Geometry of Non-metallic Dielectric Lenses, Zoning.

Unit 5 Wave Propagation **15**

Wave Propagation: Introduction, Definitions, different modes of wave propagation, Ground wave propagation (Qualitative treatment) - Introduction, Plane earth reflections, Space and surface waves, wave tilt, curved earth reflections, Space wave propagation - Introduction, field strength variation with distance and height, effect of Earth 's curvature, absorption, Super refraction, M-curves and duct propagation, scattering phenomena, tropospheric propagation. Sky wave propagation - Introduction, structure of Ionosphere, refraction and reflection of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance, Relation between MUF and Skip distance, multi-HOP propagation, Illustrative problems.

Prescribed Textbooks:

1. John D. Kraus, Ronald J. Marhefka and Ahmad S. Khan, Antennas and wave propagation, TMH, New Delhi, 4th Ed., 2010.
2. K.D. Prasad and Satya Prakashan, —Antennas and Wave Propagation‖, New Delhi, Tech. India Publications, 2001.
3. C.A. Balanis, —Antenna Theory- Analysis and Design‖, John Wiley & Sons, 2nd Edn., 2001.

Reference Books:

1. E.C. Jordan and K.G. Balmain, —Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2000.
2. G.S.N Raju, —Antenna and Wave Propagation, Pearson Education India, 3rd Edition 2009.
3. R K Shev Gaonkar, Electromagnetic Waves. Tata McGraw-Hill, 2006.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0453T. 1	3	3	3	3	2	2	2	1	2	-	-	3	1
23A0453T. 2	3	3	3	3	2	2	1	1	2	-	2	3	1
23A0453T. 3	3	3	3	3	2	2	1	1	2	-	1	3	1
23A0453T. 4	3	3	3	3	2	2	1	1	2	-	2	3	1
23A0453T. 5	3	3	3	3	2	2	1	1	2	-	2	3	3

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Title of the Course: INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS
Category: PCC
Couse Code: 23A0554T
Branch/es: ECE
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1 Introduce fundamental quantum concepts like superposition and entanglement.
2 Understand theoretical structure of qubits and quantum information.
3 Explore conceptual challenges in building quantum computers.
4 Explain principles of quantum communication and computing.
5 Examine real-world applications and the future of quantum technologies.

Course Outcomes:

At the end of the course, the student will be able to

1 Explain core quantum principles in a non-mathematical manner.
2 Compare classical and quantum information systems.
3 Identify theoretical issues in building quantum computers.
4 Discuss quantum communication and computing concepts.
5 Recognize applications, industry trends, and career paths in quantum technology

Unit 1 Introduction to Quantum Theory and Technologies 15

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison, Quantum states and measurement: nature of observation, Overview of quantum systems: electrons, photons, atoms, The concept of quantization: discrete energy levels, Why quantum? Strategic, scientific, and technological significance, A snapshot of quantum technologies: Computing, Communication, and Sensing, National and global quantum missions: India's Quantum Mission, EU, USA, China.

Unit 2 Theoretical Structure of Quantum Information Systems 12

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role.

Unit 3 Building a Quantum Computer – Theoretical Challenges and Requirements 12

What is required to build a quantum computer (conceptual overview)? Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers: Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison), Superconducting circuits, Trapped ions, Photonics, Vision vs reality: what's working and what remains elusive, The role of quantum software in managing theoretical complexities.

Unit 4 Quantum Communication and Computing – Theoretical Perspective 10

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD), Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking, Introduction to Quantum Computing, Quantum Parallelism (Many States at Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real-World Importance and Future Potential.

Unit 5 Applications, Use Cases, and the Quantum Future 10

Real-world application domains: Healthcare (drug discovery),Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum, Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization, Emerging careers in quantum: roles, skillsets, and preparation pathways, Educational and research landscape – India's opportunity in the global quantum race.

Prescribed Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.
4. Alastair I.M. Rae, Quantum Physics: A Beginner's Guide, Oneworld Publications, Revised Edition, 2005.
5. Eleanor G. Rieffel, Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
6. Leonard Susskind, Art Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014.
7. Bruce Rosenblum, Fred Kuttner, Quantum Enigma: Physics Encounters Consciousness, Oxford University Press, 2nd Edition, 2011.
8. GiulianoBenenti, GiulioCasati, GiulianoStrini, Principles of Quantum Computation and Information, Volume I: Basic Concepts, World Scientific Publishing, 2004.
9. K.B. Whaley et al., Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document, Quantum Flagship, European Commission, 2020.
10. Department of Science & Technology (DST), Government of India, National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers, MeitY/DST Publications, 2020 onward.

Online Learning Resources:

1. IBM Quantum Experience and Qiskit Tutorials
2. Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
3. edX – The Quantum Internet and Quantum Computers
4. YouTube – Quantum Computing for the Determined by Michael Nielsen
5. Qiskit Textbook – IBM Quantum

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of [illegible]	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0554T. 1	3	2	1	1	2	1	1	1	1	0	3	3	2
23A0554T. 2	3	3	2	1	2	1	1	1	1	1	3	3	2
23A0554T. 3	3	3	2	2	3	1	1	1	2	1	3	3	3
23A0554T. 4	3	3	2	2	3	1	1	2	2	1	3	3	3
23A0554T. 5	2	2	2	1	3	3	2	2	2	3	3	2	3

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Title of the Course: COMPUTER ARCHITECTURE & ORGANIZATION
Category: PEC-I
Couse Code: 23A045AT
Branch/es: ECE
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1 To learn the design of various functional units of digital computers and performance issues of computer systems.
2 To understand the basic processing unit and their connections.
3 To get familiar with different types of Data representation and Computer Arithmetic operations.
4 To know about different types of memory and their interconnections.
5 To learn the basics of parallel computing and pipelining.

Course Outcomes:

At the end of the course, the student will be able to

1 Learn the design of various functional units of digital computers and performance issues of computer systems.
2 Understand the basic processing unit and their connections.
3 Know about different types of Data representation and Computer Arithmetic operations.
4 Learn about different types of memory and their interconnections.
5 Understand the basics of parallel computing and pipelining.

Unit 1 **12**

Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.

Register Transfer Language and Micro operations: Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro-operations, shift micro-operations, Arithmetic logic shift unit.

Basic Computer Organization and Design: Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input –Output and Interrupt.

Unit 2 **9**

Micro programmed Control: Control memory, Address sequencing, micro program example, design of control unit.

Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

Unit 3 **14**

Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation.

Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

Unit 4 **10**

Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt Direct memory Access.

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

Unit 5 **11**

Reduced Instruction Set Computer: CISC Characteristics, RISC Characteristics. Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor. Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Inter-processor arbitration, Inter-processor Communication and synchronization, Cache Coherence.

Prescribed Textbooks:

1. Computer System Architecture – M. Moris Mano, Third Edition, Pearson/PHI.

Reference Books:

1 Computer Organization – Car Hamacher, ZvonksVranesic, Saretzky, Vth Edition, McGraw Hill.
2. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
3. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23A045AT.1	3	2	1	-	-	-	-	-	-	-	2	3	-
23A045AT.2	-	2	3	-	-	-	-	-	-	-	1	-	-
23A045AT.3	3	2	3	-	-	-	-	-	-	-	2	-	-
23A045AT.4	3	-	-	-	-	-	-	-	-	-	-	-	-
23A045AT.5	3	-	-	-	-	-	-	-	-	-	-	-	-

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Title of the Course: INFORMATION THEORY & CODING
Category: PEC-I
Couse Code: 23A045BT
Branch/es: ECE
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1 To provide an insight into the concept of information in the context of communication theory.
2 To implement various source coding algorithms and analyze their performance.
3 To gain knowledge about techniques for error detection and error correction.
4 To design cyclic codes and decoding of Cyclic codes.
5 To get familiar with design of convolutional codes.

Course Outcomes:

At the end of the course, the student will be able to

1 Explain the concepts of information in the context of communication theory.
2 Implement various source coding algorithms and analyze their performance.
3 Implementation and Design linear block codes.
4 Analyze Encoding and Decoding of cyclic codes.
5 Design of convolutional code and Viterbi algorithm.

Unit 1 Information Theory **9**

Introduction, Definition of Entropy, Conditional Entropy, Relative Entropy, Basic Properties of Entropy, Mutual Information, Information Inequalities, Problem solving, Prefix-free Code, Coding a single Random Variable, Prefix, Free Code, Kraft Inequality.

Unit 2 Source Coding **10**

Encoding of the Source output, Shannon's Encoding algorithm, Shannon's Fano Encoding Algorithm, Huffman Coding, Universal Source Coding: Lempel-Ziv Algorithm, Lempel-Ziv Welch Algorithm, LZW encoding & decoding, Channel Capacity of Different Channels- BSC, BEC.

Unit 3 Error Control Coding **12**

Introduction to Error Control Codes, Types of Codes, Linear Block Codes: Introduction to Linear Block Codes, Matrix Description of Linear Block Codes, Error Detection and Correction capabilities of Linear Block Codes, The Hamming Distance, Encoding Block Codes, Syndrome and Error Detection, Decoding of Block Codes.

Unit 4 Binary Cyclic Codes **12**

Introduction, Algebraic Structure of Cyclic Codes, Generator and Parity Check Matrices for Cyclic codes, Encoding of Cyclic codes using Shift Register, Syndrome Calculation, Decoding of Cyclic Codes, Introduction to BCH Codes.

Unit 5 Convolutional Codes **10**

Introduction, Time domain and Transform Domain approach, Encoder for Convolution Code, State diagram, Tree Diagram and Trellis Diagram, The Viterbi Decoding algorithm, Turbo Codes.

Prescribed Textbooks:

1 Simon Haykin, Communication Systems, John Wiley, 4th Edition, 2010

2. Digital and Analog Communication Systems, K Sam Shanmugam, John Wiley India Pvt.Ltd.1996.

Reference Books:

1 Shu Lin, Daniel J. Costello Jr., Error Control Coding, Pearson, Second Edition, 2013.

2. Herbert Taub, Donald L Shilling, Goutam Saha, Principles of Communication Systems, 4th Edition, McGraw Hill, 2017.

3. Simon Haykin, Communication Systems, John Wiley, 4th Edition, 2010.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23A045BT.1	3	3	3	3	-	-	-	-	-	-	3	2	2
23A045BT.2	3	3	3	3	-	-	-	-	-	-	3	2	2
23A045BT.3	3	3	3	3	-	-	-	-	-	-	3	2	2
23A045BT.4	3	3	3	3	-	-	-	-	-	-	3	2	2
23A045BT.5	3	3	3	3	-	-	-	-	-	-	3	2	2

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Title of the Course: DETECTION AND ESTIMATION THEORY
Category: PEC-I
Couse Code: 23A045CT
Branch/es: ECE
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1 To understand the impact of white Gaussian noise on the detection of signals.
2 To analyze the detection of deterministic signals and random signals.
3 To learn about the nonparametric detections.
4 To analyze estimation signal parameter and apply suitable estimation techniques.
5 To understand the signal estimation in Discrete-Time techniques.

Course Outcomes:

At the end of the course, the student will be able to

1 Understand the impact of white Gaussian noise on the detection of signals.
2 Analyze the detection of deterministic signals and random signals.
3 Learn about the nonparametric detections.
4 Analyze estimation signal parameters and apply suitable estimation techniques.
5 Understand the signal estimation in Discrete-Time techniques.

Unit 1 Statistical Decision Theory 12

Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain. Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, local optimum tests, detector comparison techniques, asymptotic relative efficiency.

Unit 2 Detection of Deterministic Signals, Detection of Random Signals 10

Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.

Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

Unit 3 Estimation of Signal Parameters 8

Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.

Unit 4 Estimation of Signal Parameters 12

Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

Unit 5 Signal Estimation in Discrete-Time 12

Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.

Prescribed Textbooks:

1. H. L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968
2. H.V. Poor,"An Introduction to Signal Detection and Estimation", Springer, 2/e,1998.

Reference Books:

1. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.
2. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO32**
23A045CT.1	2	3	1	3	-	-	-	-	-	-	-	2	-
23A045CT.2	2	3	3	2	-	-	-	-	-	-	-	2	-
23A045CT.3	3	2	2	2	-	-	-	-	-	-	-	2	-
23A045CT.4	2	3	3	3	-	-	-	-	-	-	-	2	-
23A045CT.5	1	2	2	3	-	-	-	-	-	-	-	2	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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R23

Title of the Course: ANALOG & DIGITAL IC APPLICATIONS LAB
Category: PCC
Couse Code: 23A0451L
Branch/es: ECE
Year: III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To design an Inverting and Non-inverting Amplifier using an Op Amp.
2. To demonstrate the Linear and Non-Linear Applications using IC 741.
3. To design A stable and Monostable Multivibrator using timer ICs.
4. To analyze the DAC and ADC converter.
5. To design Counters and Registers using digital ICs

Course Outcomes:

At the end of the course, the student will be able to

1. Design an Inverting and Non-inverting Amplifier using an Op Amp.
2. Demonstrate the Linear and Non-Linear Applications using IC 741.
3. Design Astable and Monostable Multivibrator using timer ICs.
4. Analyze the DAC and ADC converter.
5. Design Counters and Registers using digital ICs.

LIST OF EXPERIMENTS: (At least 8 Linear and 4 Digital IC experiments shall be performed)

1. Design an Inverting and Non-inverting Amplifier using Op Amp and calculate gain.
2. Design Adder and Subtractor using Op Amp and verify addition and subtraction process.
3. Design a Comparator using Op Amp and draw the comparison results of A=B, A>B, A<B
4. Design an Integrator and Differentiator Circuits using IC741 and derive the required condition practically.
5. Design an Active LPF, HPF cutoff frequency of 2 KHZ and find the roll off it.
6. Design a Circuit using IC741 to generate sine/square/triangular wave with period of 1KHZ and draw the output waveform.
7. Construct Mono-stable Multivibrator using IC555 and draw its output waveform.
8. Construct Astable Multivibrator using IC555 and draw its output waveform and find its duty cycle.
9. Design a Schmitt Trigger Circuit and find its LTP and UTP.
10. Design Voltage Regulator usingIC723, IC 7805/7809/7912 and find its load regulation factor.
11. Design R-2R ladder DAC and find its resolution and write a truth table with respective voltages.
12. Design Parallel comparator type/ counter type/ successive approximation ADC and find its efficiency.

13. Design a 8x1 multiplexer using digital ICs.
14. Design a 4-bit Adder/Subtractor using digital ICs
15. Design a Decade counter and verify its truth table and draw respective waveforms.
16. Design a Up/down counter usingIC74163 and draw read/write waveforms.
17. Design a Universal shift register using IC 74194/195 and verify its shifting operation.
18. Design an 8x3 encoder/3x8 decoder and verify its truth table.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23A0451L.1	3	3	3	3	-	-	-	-	-	-	-	3	-
23A0451L.2	3	3	3	3	-	-	-	-	-	-	-	3	-
23A0451L.3	3	3	3	3	-	-	-	-	-	-	-	3	-
23A0451L.4	3	3	3	3	-	-	-	-	-	-	-	3	-
23A0451L.5	3	3	3	3	2	-	-	-	-	-	-	3	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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R23

Title of the Course: MICROPROCESSORS AND MICROCONTROLLERS LAB
Category: PCC
Couse Code: 23A0452L
Branch/es: ECE
Year: III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To become skilled in 8086 Assembly Language programming.
2. To understand the detailed software and hardware structure of the microprocessor.
3. Train their practical knowledge through laboratory experiments.
4. To understand and learn 8051 Microcontroller.
5. To acquire knowledge on microprocessors and microcontrollers, interfacing various peripherals, and configuring.

Course Outcomes:

At the end of the course, the student will be able to

1. Formulate a program and implement algorithms using Assembly language. (L2).
2. Describe an Assembly language program for the 8086 Microprocessor. (L6).
3. Develop programs for different applications in the 8086 Microprocessor. (L3).
4. Interface peripheral devices with 8086 and 8051. (L6).
5. Use an Assembly/Embedded C programming approach for solving real-world problems(L3).

List of Experiments: (Any TEN of the experiments are to be conducted)

EXP 1	**Programs for 16 Bit Arithmetic Operations** (Using various addressing modes)

a) Write an ALP to Perform Addition and Subtraction of Multi precision numbers.
b) Write an ALP to Perform Multiplication and division of signed and unsigned Hexadecimal numbers.
c) Write an ALP to find square, cube and factorial of a given number.

EXP 2	**Programs Involving Bit Manipulation Instructions**

a) Write an ALP to find if the data given is positive or negative.
b) Write an ALP to find if the given data is odd or even.
c) Write an ALP to find Logical ones and zeros in each data.

EXP 3	**Programs on Arrays for 8086**

a) Write an ALP to find Addition/subtraction of N nos.
b) Write an ALP to find largest/smallest no.
c) Write an ALP to sort a given array in Ascending/descending order.

EXP 4	**Programs on String Manipulations for 8086**

a) Write an ALP to find String length.
b) Write an ALP for Displaying the given Strings
c) Write an ALP for Comparing two Strings.
d) Write an ALP to reverse String and Checking for palindrome.

EXP 5	Programs for Digital Clock Design Using 8086

a) Write an ALP for Designing clock using INT 21H Interrupt.
b) Write an ALP for Designing clock using DOS Interrupt Functions.
c) Write an ALP for Designing clock by reading system time

EXP 6	Interfacing Stepper Motor with 8086

a) Write an ALP to 8086 processor to Interface a stepper motor and operate it in clockwise by choosing variable step-size.
b) Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise by choosing variable step-size.

EXP 7	Interfacing ADC/DAC with 8086

a) Write an ALP to 8086 processor to Interface ADC.
b) Write an ALP to 8086 processor to Interface DAC and generate Square Wave/Triangular Wave/Step signal.

EXP 8	Communication between Two Microprocessors

a) Write an ALP to have Parallel communication between two microprocessors using 8255
b) Write an ALP to have Serial communication between two microprocessor kits using 8251.

EXP 9	Programs using Arithmetic and Logical Instructions for 8051

a) Write an ALP to 8051 Microcontroller to perform Arithmetic operations like addition, subtraction,
b) Multiplication and Division.
c) Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR.
d) Programs related to Register Banks.

EXP 10	Programs to Verify Timers/Counters of 8051

a) Write a program to create a delay of 25msec using Timer0 in mode 1 and blink all the Pins of P0.
b) Write a program to create a delay of 50 μsec using Timer1 in mode 0 and blink all the Pins of P2.
c) Write a program to create a delay of 75msec using counter0 in mode 2 and blink all the Pins of P1.
d) Write a program to create a delay of 80 μsec using counter1 in mode 1 and blink all the Pins of P3.

EXP 11	UART Operation in 8051

a) Write a program to transfer a character serially with a baud rate of 9600 using UART.
b) Write a program to transfer a character serially with a baud rate of 4800 using UART.
c) Write a program to transfer a character serially with a baud rate of 2400 using UART.

EXP 12	Interfacing LCD with 8051

a) Develop and execute the program to interface16*2 LCD to 8051.
b) Develop and execute the program to interface LCD to 8051 in 4-bit or 8-bit mode.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23A0452L.1	2	1	1	1	-	-	1	2	-	-	1	1	-
23A0452L.2	3	3	3	3	-	-	1	2	-	-	1	2	-
23A0452L.3	3	2	1	1	3	-	1	2	2	-	1	2	-
23A0452L.4	3	3	3	3	-	-	1	2	-	-	1	2	-
23A0452L.5	3	2	1	1	3	-	1	2	2	2	1	2	-

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R23

Title of the Course: **VHDL Programming**
Category: SEC
Couse Code: 23A0453L
Branch/es: ECE
Year: III B. Tech
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
	1	2	2

Course Objectives:

1.To understand and implement basic combinational logic circuits using HDL

2. Understand the functionality and application of basic logic gates in combinational circuits.

3. Design and implement combinational circuits such as adders, subtractors, multiplexers, decoders, and comparators.

4. Analyze and construct sequential circuits including flip-flops, counters, and finite state machines.

5. Simulate and test the working of digital systems using HDL/behavioral modeling tools.

Course Outcomes:

1. At the end of the course, the student will be able to
2. Implement basic logic gates, adders, and subtractors.
3. Design and test combinational circuits like multiplexers, decoders, encoders, and comparators.
4. Construct sequential circuits using flip-flops and counters.
5. Model and simulate FSMs and simple ALUs using behavioral VHDL.
6. Demonstrate digital system building skills through practical experiments

List of Experiments: (Any TEN of the experiments are to be conducted)

EXP 1	Basic Gates, Adders, Subtractors Dataflow/Behavioral
EXP 2	Decoders Dataflow/Behavioral
EXP 3	Multiplexers & Demultiplexers Dataflow/Behavioral
EXP 4	ALU Dataflow/Behavioral
EXP 5	Flip-Flops Behavioral/Structural
EXP 6	Counters Behavioral Dataflow/Behavioral
EXP 7	Code Converters Dataflow/ Structural
EXP 8	Encoders With and Without Priority Dataflow/Behavioral

EXP 9	Comparator Dataflow/Behavioral

EXP 10	Seven Segment Display Dataflow/Structural

EXP 11	FSMs Behavioral

EXP 12	Multipliers Structural

CO-POMapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23A0453L.1	3	2	2	1	2	--	--	--	--	--	--	3	--
23A0453L.2	3	3	3	2	2	--	--	--	--	--	--	3	--
23A0453L.3	3	3	3	2	2	--	--	--	--	--	--	3	--
23A0453L.4	3	3	3	3	3	--	--	--	--	--	--	3	--
23A0453L.5	2	2	2	2	3	--	--	3	--	--	--	3	--

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R23

Title of the Course: TINKERING LAB FOR ELECTRONIC ENGINEERS
Category: SEC
Couse Code: 23A0454L
Branch/es: ECE
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
-	-	2	1

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Objectives:

1. Encourage Innovation and Creativity.
2. Provide Hands-on Learning and Impart Skill Development.
3. Foster Collaboration and Teamwork.
4. Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship
5. Impart Problem-Solving mind-set

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to startups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

Course Outcomes:

At the end of the course, the student will be able to

1. To generate innovative ideas and demonstrate creative thinking in developing solutions, designs, or projects.
2. To apply theoretical knowledge through hands-on activities and develop technical and practical skills relevant to the subject domain.
3. To work effectively in teams, demonstrating communication, coordination, and collaborative problem-solving skills.
4. To integrate knowledge from various disciplines and apply it to solve real-world problems, showcasing readiness for industrial roles or entrepreneurial ventures.
5. To identify, analyze, and solve complex problems using logical reasoning, critical thinking, and appropriate tools and techniques.

LIST OF EXPERIMENTS:

1. Make your own parallel and series circuits using breadboard for any application of your choice.
2. Design and 3D print a Walking Robot
3. Design and 3D Print a Rocket.
4. Temperature & Humidity Monitoring System (DHT11 + LCD)
5. Water Level Detection and Alert System
6. Automatic Plant Watering System
7. Bluetooth-Based Door Lock System
8. Smart Dustbin Using Ultrasonic Sensor
9. Fire Detection and Alarm System
10. RFID-Based Attendance System
11. Voice-Controlled Devices via Google Assistant
12. Heart Rate Monitoring Using Pulse Sensor

13. Soil Moisture-Based Irrigation
14. Smart Helmet for Accident Detection
15. Milk Adulteration Detection System
16. Water Purification via Activated Carbon
17. Solar Dehydrator for Food Drying
18. Temperature-Controlled Chemical Reactor
19. Ethanol Mini-Plant Using Biomass
20. Smart Fluid Flow Control (Solenoid + pH Sensor)
21. Portable Water Quality Tester
22. AI Crop Disease Detection
23. AI-based Smart Irrigation
24. ECG Signal Acquisition and Plotting
25. AI-Powered Traffic Flow Prediction
26. Smart Grid Simulation with Load Monitoring
27. Smart Campus Indoor Navigator
28. Weather Station Prototype
29. Firefighting Robot with Sensor Guidance
30. Facial Recognition Dustbin
31. Barcode-Based Lab Inventory System
32. Growth Chamber for Plants
33. Biomedical Waste Alert System
34. Soil Classification with AI
35. Smart Railway Gate
36. Smart Bin Locator via GPS and Load Sensors
37. Algae-Based Water Purifier
38. Contactless Attendance via Face Recognition

- **Note:** The students can also design and implement their own ideas, apart from the list of experiments mentioned above.
- **Note:** A minimum of 8 to 10 experiments must be completed by the students.

Students need to refer to the following links:

1) https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2) https://atl.aim.gov.in/ATL-Equipment-Manual/
3) https://aim.gov.in/pdf/Level-1.pdf
4) https://aim.gov.in/pdf/Level-2.pdf
5) https://aim.gov.in/pdf/Level-3.pdf

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and	Life-long learning	**PSO1**	**PSO2**
23A0454L.1	**2**	2	**3**	2	**3**	--	--	--	--	--	--	3	3
23A0454L.2	**3**	2	**3**	2	**3**	--	--	--	--	--	--	3	2
23A0454L.3	**2**	1	**2**	-	**2**	--	--	--	--	--	--	1	3
23A0454L.4	**2**	2	**3**	3	**3**	1	1	--	--	--	--	3	3
23A0454L.5	**3**	3	**3**	3	**2**	--	--		--	--	--	3	2

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R23

Title of the Course: **GREEN BUILDINGS**
Category: OEC-1
Couse Code: 23A015DT
Branch/es: EEE/ME/ECE/CSE & Allied
Semester: V

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

The objectives of this course are to make the student:

1. To understand the fundamental concepts of green buildings, their necessity, and sustainable features.
2. To analyze green building concepts, rating systems, and their benefits in India.
3. To apply green building design Principles, energy efficiency measures, and renewable energy sources.
4. To evaluate air conditioning systems, HVAC designs, and energy modeling for sustainable buildings.
5. To assess material conservation strategies, waste management, and indoor environmental quality in green buildings.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand the importance of green buildings, their necessity, and sustainable features.
2. Analyze various green building practices, rating systems, and their impact on environmental sustainability.
3. Apply principles of green building design to enhance energy efficiency and incorporate renewable energy sources.
4. Evaluate HVAC systems, energy-efficient air conditioning techniques, and their role in sustainable building design.
5. Assess material conservation techniques, waste reduction strategies, and indoor air quality management in green buildings.

Unit 1 **Introduction** 8

Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing A Green Building, Important Sustainable Features for Green Buildings.

Unit 2 **Concepts and Practices** 8

Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.

Unit 3 **Building Design** 8

Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-Friendly Captive Power Generation for Factories, Building Requirements.

Unit 4 **Air Conditioning** 10

Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling towers, Selection of Air Handling Units, Pre-Cooling of Fresh Air, Interior Lighting Systems, Key Features of The Building, Eco-Friendly Captive Power Generation for Factories, Building Requirements.

Unit 5 **Material Conservation** 10

Handling of Non-Process Waste, Waste Reduction During Construction, Materials with Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health– Air Conditioning, Indoor Air Quality, Sick Building Syndrome, tobacco Smoke.

Prescribed Textbooks:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Green Building Handbook by tom woolley and Sam kimings, 2009.

Reference Books:

1. Complete Guide to Green Buildings by Trish riley.
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009
3. Energy Conservation Building Code –ECBC-2020, published by BEE

Online Learning Resources:

https://archive.nptel.ac.in/courses/105/102/105102195/

CO-PO Mapping:

Course Outcomes	Engineering	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	Engineering and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and	Life-long learning	PSO1	PSO2
23A015DT.1	3	-	-	-	-	2	3	-	-	-	-	-	3	3
23A015DT.2	-	3	-	-	2	-	3	-	-	-	-	2	3	3
23A015DT.3	-	-	3	3	3	-	3	-	-	-	-	-	3	3
23A015DT.4	-	-	3	3	3	-	3	-	-	-	-	-	3	3
23A015DT.5	-	-	-	-	-	3	3	3	2	-	-	-	-	3

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R23

Title of the Course: **CONSTRUCTION TECHNOLOGY AND MANAGEMENT**
Category: OEC-1
Couse Code: 23A015ET
Branch/es: EEE/ME/ECE/CSE & Allied
Semester: V

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1. To understand project management fundamentals, organizational structures, and leadership principles in construction.
2. To analyze manpower planning, equipment management, and cost estimation in civil engineering projects.
3. To apply planning, scheduling, and project management techniques such as CPM and PERT.
4. To evaluate various contract types, contract formation, and legal aspects in construction management.
5. To assess safety management practices, accident prevention strategies, and quality management systems in construction.

Course Outcomes:

At the end of the course, the student will be able to

1. Comprehend project management fundamentals, organizational structures, and leadership principles in construction.
2. Analyze manpower planning, equipment management, and cost estimation in civil engineering projects.
3. Apply planning, scheduling, and project management techniques such as CPM and PERT.
4. Evaluate various contract types, contract formation, and legal aspects in construction management.
5. Assess safety management practices, accident prevention strategies, and quality management systems in construction.

Unit 1 Introduction: 8

Types of Projects, Management Objectives and Functions; Organizational Chart of a Construction Company; Manager's Duties and Responsibilities; Public Relations; Leadership and Team - Work; Ethics, Morale, Delegation and Accountability.

Unit 2 Man and Machine 8

Man-Power Planning, Training, Recruitment, Motivation, Welfare Measures and Safety Laws; Machinery for Civil Engineering., Earth Movers and Hauling Costs, Factors Affecting Purchase, Rent, and Lease of Equipment, and Cost Benefit Estimation.

Unit 3 Planning, Scheduling and Project Management 8

Planning Stages, Construction Schedules and Project Specification, Monitoring and Evaluation; Bar-Chart, CPM, PERT, Network- formulation and Time Computation.

Unit 4 Contracts 10

Types of Contracts, formation of Contract– Contract Conditions – Contract for Labour, Material, Design, Construction Drafting of Contract Documents Based on IBRD/ MORTH Standard Bidding Documents –

Construction Contracts – Contract Problems– Arbitration and Legal Requirements Computer Applications in Construction Management: Software for Project Planning, Scheduling and Control.

Unit 5 Safety Management 10

Implementation and Application of QMS in Safety Programs, ISO9000 Series, Accident Theories, Cost of Accidents, Problem Areas in Construction Safety, Fall Protection, Incentives, Zero Accident Concepts, Planning for Safety, Occupational Health and Ergonomics.

Prescribed Textbooks:

1. Construction Project Management, S K.Sears, G A.Sears, R H. Clough, John Wiley and Sons, 6th Edition, 2016.
2. Construction Project Scheduling and Control by Saleh Mubarak, 4th Edition, 2019

Reference Books:

1. Brien, J.O. and Plotnick, F.L., CPM in Construction Management, Mc Graw Hill, 2010.
2. Punmia, B.C., and Khandelwal, K.K., Project Planning and control with PERT and CPM, Laxmi Publications, 2002.
3. Construction Methods and Management: Pearson New International Edition 8th Edition Stephens Nunnally.
4. Rhoden, M and Cato B, Construction Management and Organizational Behavior, Wiley-Blackwell, 2016.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/105/104/105104161/
2. https://archive.nptel.ac.in/courses/105/103/105103093/

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	Engineering and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A015ET.1	3	-	-	-	-	2	-	2	2	-	-	-	3	3
23A015ET.2	-	3	-	-	2	-	-	-	-	-	-	2	3	3
23A015ET.3	-	-	3	3	3	-	-	-	-	2	-	-	3	3
23A015ET.4	-	-	3	3	3	-	-	2	-	-	-	-	3	3
23A015ET.5	-	-	-	-	-	3	3	3	2	-	-	-	-	3

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R23

Title of the Course: Electrical Safety Practices and Standards
Category: OEC -I
Course Code: 23A025ET
Branch/es: CSE/ECE/ME/Civil
Year: III
Semester: I

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. Explain the physiological effects of electric shock and identify various hazards of electricity including arc and blast based on safety requirements.
2. Classify conductors, insulators, and voltage types, and evaluate the use of appropriate electrical safety equipment and fire extinguishers.
3. Interpret grounding and bonding requirements and determine safe approach distances and arc hazard categories based on earthing practices.
4. Demonstrate appropriate safety practices in handling electrical appliances and installations across various environments through real-life case studies.
5. Analyze national and international electrical safety standards (e.g., NFPA 70E, OSHA, NEC, NESC) and apply statutory compliance as per the Electricity Act and regulations.

Course Outcomes:

At the end of the course, the student will be able to …

1. Analyze national and international electrical safety standards and apply statutory compliance as per the Electricity Act and regulations.
2. Classify various electrical safety components including conductors, insulators, voltage levels, and select suitable protection methods for overvoltage and static electricity.
3. Explain grounding and bonding principles and calculate safe approach distances and arc hazard levels using earthing system standards.
4. Demonstrate appropriate electrical safety practices in domestic, industrial, and public environments, and evaluate real-world case studies for safety effectiveness.
5. Compare various electrical safety standards and interpret statutory compliance requirements from governing authorities.

Unit 1 Introduction To Electrical Safety **9**

Fundamentals of Electrical safety - Electric Shock- physiological effects of electric current - Safety requirements - Hazards of electricity - Arc - Blast - Causes for electrical failure.

Unit 2 Safety Components **9**

Introduction to conductors and insulators - voltage classification - safety against over voltages - safety against static electricity - Electrical safety equipment - Fire extinguishers for electrical safety.

Unit 3 Grounding **9**

General requirements for grounding and bonding - Definitions- System grounding - Equipment grounding The Earth - Earthing practices - Determining safe approach distance - Determining arc hazard category.

Unit 4 Safety Practices **9**

General first aid - Safety in handling handheld electrical appliances tools - Electrical safety in train stations- swimming pools, external lighting installations, medical locations - Case studies.

Unit 5 Standards For Electrical Safety **9**

Electricity Acts - Rules & regulations - Electrical standards - NFPA 70 E-OSHA standards - IEEE standards- National Electrical Code 2005 - National Electric Safety code NESC - Statutory requirements from electrical inspectorate

Prescribed Textbooks:

1. Massimo A. G. Mitolo - Electrical Safety of Low-Voltage Systems, McGraw Hill, USA, 2009.
2. Mohamed El-Sharkawi - Electric Safety - Practice and Standards, CRC Press, USA, 2014.

Reference Books:

1. Kenneth G. Mastrullo, Ray A. Jones - The Electrical Safety Program Book‖, Jones and Bartlett Publishers, London, 2nd Edition, 2011.
2. Palmer Hickman - Electrical Safety - Related Work Practices, Jones & Bartlett Publishers, London, 2009.
3. Fordham Cooper, W. - Electrical Safety Engineering‖, Butterworth and Company, London, 1986.
4. John Cadick, Mary Capelli - Schellpfeffer, Dennis K. Neitzel - Electrical Safety Hand book, McGraw - Hill, New York, USA, 4th edition, 2012.

Web Resources:

https://www.youtube.com/watch?v=_s24Gn43mVs
https://www.youtube.com/@NOUCS-ey8iq

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A025ET.1	3	2	-	-	2	-	-	-	-	-	-	3	2
23A025ET.2	3	3	-	-	2	-	-	-	-	-	-	3	2
23A025ET.3	3	2	-	-	2	-	-	-	-	-	-	3	3
23A025ET.4	3	2	-	-	3	-	-	-	-	-	-	3	3
23A025ET.5	3	2	-	-	3	-	-	-	-	-	-	3	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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R23

Title of the Course: JAVA PROGRAMMING
Category: OEC-1
Couse Code: 23A055ET
Year: III B. Tech
Semester: I Semester
Branch: CE, EEE, ME, ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives: This course will be able to
1. Identify Java language components and how they work together in applications
2. Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
3. Learn how to extend Java classes with inheritance and dynamic binding and how to use exception
4. Understand how to design applications with threads in Java
5. Understand how to use Java APIs for program development

Course Outcomes:

At the end of the course, the student will be able to
1. Analyse problems, design solutions using OOP principles, and implement them efficiently in Java. (L4)
2. Design and implement classes to model real-world entities, with a focus on attributes, behaviours, and relationships between objects. (L4)
3. Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and dynamic method dispatch. (L3)
4. Apply Competence in handling exceptions and errors to write robust and fault-tolerant code. (L3)
5. Perform file input/output operations, including reading from and writing to files using Java I/O classes, graphical user interface (GUI) programming using JavaFX. (L3)
6. Choose appropriate data structure of Java to solve a problem. (L6)

Unit 1

Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style. Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators. Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operators, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, for–each for Loop, Break Statement, Continue Statement.

Unit 2

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

Unit 3

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

Unit 4

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java. lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throw able, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2)

Unit 5

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer. **Multithreaded Programming:** Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter thread Communication - Suspending, Resuming, and Stopping of Threads.

Java Database Connectivity: Introduction, JDBC Architecture, Installing My SQL and My SQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result Set Interface Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Learning Resources:

Textbooks:

1. JAVA one step ahead, Anitha Seth, B.L. Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object-Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

1. The complete Reference Java, 11thedition, Herbert Schildt, MH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Learning Resources:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347 _shared/overview

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R23

Title of the Course:	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE
Category:	OEC-1
Couse Code:	23A055FT
Year:	III B. Tech
Semester:	I Semester
Branch:	CE, EEE, ME, ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives: This course will be able to

1. To learn the distinction between optimal reasoning Vs. human like reasoning.
2. To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
3. To learn different knowledge representation techniques.
4. To understand the applications of AI, namely game playing, theorem proving, and machine learning.

Course Outcomes:

At the end of the course, the student will be able to

1. Learn the distinction between optimal reasoning Vs human like reasoning and formulate an efficient problem space for a problem expressed in natural language. Also select a search algorithm for a problem and estimate its time and space complexities.
2. Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.
3. Learn different knowledge representation techniques.
4. Comprehend the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
5. Comprehend the applications of Probabilistic Reasoning and Bayesian Networks.

Unit 1

Introduction to AI: Intelligent Agents, Problem-Solving Agents, Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

Unit 2

Games: Optimal Decisions in Games, Alpha–Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, Logic- Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

Unit 3

First-Order Logic: Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution. Knowledge Representation: Ontological Engineering, Categories and Objects, Events.

Unit 4

Planning: Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning.

Unit 5

Probabilistic Reasoning: Acting under Uncertainty, Basic Probability Notation Baye's Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First- Order Probability.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

REFERENCE BOOKS:

1. Artificial Intelligence, 3rd Edn., E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pea

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R23

Title of the Course: MATHEMATICS FOR MACHINE LEARNING AND AI
Category: OEC I
Couse Code: 23AHS51T
Branch/es: Common to All Branches
Year III year
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1. To provide a strong mathematical foundation for understanding and developing AI/ML algorithms.
2. To enhance the ability to apply linear algebra, probability, and calculus in AI/ML models.
3. To equip students with optimization techniques and graph-based methods used in AI applications.
4. To develop critical problem-solving skills for analysing mathematical formulations in AI/ML.

Course Outcomes:

At the end of the course, the student will be able to

1. Apply linear algebra concepts to ML techniques like PCA and regression.
2. Analyze probabilistic models and statistical methods for AI applications.
3. Implement optimization techniques for machine learning algorithms.
4. Utilize vector calculus and transformations in AI-based models.
5. Develop graph-based AI models using mathematical representations.

Unit 1 Linear Algebra for Machine Learning **8**

Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigenvalues, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

Unit 2 Probability and Statistics for AI **8**

Probability distributions: Gaussian, Binomial, Poisson. Bayes'Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP). Entropy and Kullback-Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.

Unit 3 Optimization Techniques for ML **8**

Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT(Karush-Kuhn-Tucker) conditions. Gradient Descent and its variants (Momentum, Adam) Newton's method, BFGS(Brayden-Fletcher-Goldfarb-Shanno) method.

Unit 4 Vector Calculus & Transformations **8**

Vector calculus: Gradient, divergence, curl. Fourier Transform & Laplace Transform in ML applications.

Unit 5 Graph Theory for AI **8**

Graph representations: Adjacency matrices, Laplacian matrices. Bayesian Networks & Probabilistic Graphical Models. Introduction to Graph Neural Networks (GNNs).

Prescribed Textbooks:

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
2. Pattern Recognition and Machine Learning by Christopher Bishop, Springer..

Reference Books:

1. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.
2. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.

Web References:

1. MIT– Mathematics for Machine Learning https://ocw.mit.edu
2. Stanford CS229 – Machine Learning Course https://cs229.stanford.edu/
3. DeepAI – Mathematical Foundations for AI https://deepai.org

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23AHS51T.1	3	3	2	2	1	-	-	-	-	-	1	-	-
23AHS51T.2	3	3	2	3	2	-	-	-	-	-	2	-	-
23AHS51T.3	3	3	3	3	2	1	-	-	-	-	2	-	-
23AHS51T.4	3	3	2	2	1	-	-	-	-	-	1	-	-
23AHS51T.5	3	3	3	3	2	-	-	-	-	-	2	-	-

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R23

Title of the Course: MATERIALS CHARACTERIZATION TECHNIQUES
Category: OEC I
Couse Code: 23AHS52T
Branch/es: Common to all branches
Year III Year
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1. To provide exposure to different characterization techniques.
2. To explain the basic principles and analysis of different spectroscopic techniques.
3. To elucidate the working of Scanning electron microscope - Principle, limitations and applications.
4. To illustrate the working of the Transmission electron microscope (TEM) - SAED patterns and its applications.
5. To educate the uses of advanced electric and magnetic instruments for characterization.

Course Outcomes:

At the end of the course, the student will be able to

1. Analyze the crystal structure and crystallite size by various methods
2. Analyze the morphology of the sample by using a Scanning Electron Microscope
3. Analyze the morphology and crystal structure of the sample by using Transmission Electron Microscope.
4. Explain the principle and experimental arrangement of various spectroscopic techniques.
5. Identify the construction and working principle of various Electrical & Magnetic Characterization technique

Unit 1 Structure analysis by Powder X-Ray Diffraction 9

Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherer and Williamson-Hall (W-H) Methods, Small angle X- ray scattering (SAXS) (in brief).

Unit 2 Microscopy technique -1 –Scanning Electron Microscopy (SEM) 9

Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

Unit 3 Microscopy Technique -2 - Transmission Electron Microscopy (TEM) 9

Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy

Unit 4 Spectroscopy techniques 9

Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

Unit 5 Electrical & Magnetic Characterization techniques 9

Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

Prescribed Textbooks:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2013.
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008

Reference Books:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity& Stuart R Stocks, Prentice Hall , 2001 – Science.
3. Practical Guide to Materials Characterization: Techniques and Applications - Khalid Sultan – Wiley – 2021.
4. Materials Characterization Techniques -Sam Zhang, Lin Li, Ashok Kumar -CRC Press - 2008

NPTEL courses link:

1. https://nptel.ac.in/courses/115/103/115103030/
2. https://nptel.ac.in/content/syllabus_pdf/113106034.pdf
3. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS52T.1	3	3	2	2	1	-	-	-	-	-	-	-	-
23AHS52T.2	3	3	2	1	1	-	-	-	-	-	-	-	-
23AHS52T.3	3	3	2	1	1	-	-	-	-	-	-	-	-
23AHS52T.4	3	2	1	1	-	-	-	-	-	-	-	-	-
23AHS52T.5	3	3	1	1	-	-	-	-	-	-	-	-	-

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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R23

Title of the Course: CHEMISTRY OF ENERGY SYSTEMS
Category: OEC I
Couse Code: 23AHS53T
Branch/es: Common to all branches
Year III
Semester: I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

1. To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
2. To understand the basic concepts of processing and limitations of Fuel cells & their applications.
3. To impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications
4. To know the necessity of harnessing alternate energy resources such as solar energy and its basic concepts.
5. To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand electrochemical concepts and battery technologies with their practical applications.
2. Apply the principles of fuel cell technology to explain their design, working, classification, efficiency, and applications, including PEM and SOFC types.
3. Apply the concepts of photochemical cells to understand their working, specificity, advantages in photo electrocatalytic conversions, and practical applications.
4. Analyze the principles of solar energy conversion to differentiate between photovoltaic and concentrated solar power technologies and evaluate the performance and applications of solar cells.
5. Analyze hydrogen storage and delivery methods by comparing their mechanisms, advantages, and limitations.

Unit 1 Electrochemical Systems 9

Introduction to electrodes, concepts, electrochemical reactions, Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries – Introduction, primary battery-Zn/air, secondary battery, Lithium-ion batteries and their applications.

Unit 2 Fuel Cells 9

Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells-Methanol oxygen fuel cell, fuel cell, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.

Unit 3 Photo and Photo electrochemical Conversions 9

Photochemical cells-Introduction and application, photochemical reactions- Electricity generation using Dye-Sensitized Solar Cells (DSSCs), specificity of photo electrochemical cell (PEC)- Water Splitting (Hydrogen Generation), advantage of photoelectron catalytic conversions and their applications.

Unit 4 Solar Energy 9

Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells-Types, Construction, working principle of PN junction, and electricity generation through light-induced charge separation and applications.

Unit 5 Hydrogen Storage 9

Introduction-Hydrogen fuel, Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel, and Organic hydrogen carriers.

Prescribed Textbooks:

1. Ira N. Levine Physical Chemistry, 6th edition, McGraw-Hill Education, 2011
2. Bahl, A., Bahl, B. S., & Tuli, G. D. Essentials of physical chemistry. New Delhi: S. Chand. 2010.

Reference Books:

1. Fuel Cell Hand Book, 7th Edition, by US Department of Energy (EG&G technical services and corporation)
2. Arvind, & Shyam. (2018). Handbook of Solar Energy: Theory, Analysis and Applications. Springer.
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al. (2014) Delft University of Technology, Delft.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS53T.1	3	2	2	1	-	-	-	-	-	-	1
23AHS53T.2	3	2	2	1	-	-	-	-	-	-	1
23AHS53T.3	3	2	2	1	-	-	-	-	-	-	1
23AHS53T.4	3	2	2	1	-	-	-	-	-	-	1
23AHS53T.5	3	2	2	1	-	-	-	-	-	-	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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R23

Title of the Course: ENGLISH FOR COMPETITIVE EXAMINATIONS
Category: OEC - I
Couse Code: 23AHS54T
Branch/es: Common to all branches
Year III B. Tech
Semester I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	-	-	3

Course Objectives:

6. To raise awareness of the importance of English for competitive exams
7. To understand the grammatical aspects and identify the errors
8. To enhance verbal ability and identify the errors
9. To enrich vocabulary to face competitive exams and for effective expression
10. To equip learners with the skills and confidence needed to succeed in competitive exams.

Course Outcomes:

At the end of the course, the student will be able to

6. Identify the basics of English grammar and its importance
7. Explain the use of grammatical structures in sentences
8. Demonstrate the ability to use various concepts in grammar and vocabulary and their applications in everyday use and in competitive exams L3
9. Analyze an unknown passage and reach conclusions about it.
10. Use correct verb forms and improve speed reading and comprehension to excel in competitive exams

Unit 1 GRAMMAR-1 9

Nouns-classification-errors-Pronouns-types-errors-Adjectives-types-errors-Articles-definite-indefinite - Adverbs-types- errors-Conjunctions-usage

Unit 2 GRAMMAR-2 9

Verbs-tenses- structure-usages- negatives- positives- time adverbs-Sequence of tenses--If Clause- Voice-active voice and passive voice- -Degrees of Comparison -reported Speech-Agreement- subject and verb-Modals-Spotting Errors-Practices.

Unit 3 VERBAL ABILITY 9

Sentence completion-Verbal analogies-Word Groups-Instructions-Critical reasoning-Verbal deduction-Select appropriate pair-Reading Comprehension-Paragraph-Jumbles

Unit 4 READING COMPREHENSION AND VOCUBULARY 9

READING COMPREHENSION AND VOCUBULARY

Reading Comprehension Skills-Competitive Vocabulary: Word Building – Memory Techniques-Synonyms, Antonyms, Affixes-Prefix &Suffix-One-word substitutes-Compound Words-Phrasal Verbs-Idioms and Phrases-Homophones- Linking Words-Modifiers-Intensifiers.

Unit 5 WRITING FOR COMPETITIVE EXAMINATIONS 9

Punctuation- Spelling rules- Word Order-Sub Skills of Writing- Paragraph- meaning-salient features- types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing-Expansion of proverbs

Prescribed Textbooks:

3. Wren & Martin, English for Competitive Examinations, S.Chand & Co, 2021
4. Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.Polymer science-

Reference Books:

4. Hari Mohan Prasad, Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.
5. Philip Sunil Solomon, English for Success in Competitive Exams, Oxford 2016
6. Shalini Verma, Word Power Made Handy, S Chand Publications
7. Neira, Anjana Dev & Co. Creative Writing: A Beginner's Manual. Pearson Education India, 2008.
8. Abhishek Jain, Vocabulary Learning Techniques Vol.I&II,RR Global Publishers 2013.
9. Michel Swan, Practical English Usage, Oxford,2006

References

1. https://www.grammar.cl/english/parts-of-speech.htm
2. https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech
3. https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active-passive-voice
4. https://languagetool.org/insights/post/verb-tenses/
5. https://www.britishcouncil.in/blog/best-free-english-learning-resources-british-council
6. https://www.careerride.com/post/social-essays-for-competitive-exams-586.aspx

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	Engineering and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning
23AHS54T-1	-	-	-		-	-	-	-	3	-	3
23AHS54T-2	-	-	-	-	-	-	-	-	3	-	3
23AHS54T-3	-	-	-	-	-	-	-	-	3	-	3
23AHS54T-4	-	-	-	-	-	-	-	-	3	-	3
23AHS54T-5	-	-	-	-	-	-	-	-	3	-	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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R23

Title of the Course: **ENTREPRENEURSHIP AND NEW VENTURE CREATION**
Category: OEC-1
Course Code: 23AHS56T

Year: III B. Tech
Semester I Semester
Branch ECE

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

- To foster an entrepreneurial mind-set for venture creation and intrapreneurial leadership.
- To encourage creativity and innovation.
- To enable them to learn pitching and presentation skills.
- To make the students understand MVP development and validation techniques to determine Product-Market fit and Initiate Solution design, Prototype for Proof of Concept.
- To enhance the ability of analyzing Customer and Market segmentation, estimate Market size, develop and validate Customer Persona

Unit 1 **Entrepreneurship Fundamentals and context** **12**

Meaning and concept- attributes and mindset of entrepreneurial and intrapreneurial leadership- role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset- skill sets- attributes and networks while on campus.

Unit 2 **Problem & Customer Identification** **12**

Understanding and analysing the macro-Problem and Industry perspective - technological, socioeconomic and urbanization trends and their implication on new opportunities - Identifying passion - identifying and defining problem using Design thinking principles - Analysing problem and validating with the potential customer - Understanding customer segmentation, creating and validating customer personas.

Unit 3 **Solution design, Prototyping & Opportunity Assessment and Sizing** **12**

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer‘s needs and create a strong value proposition - Understanding prototyping and Minimum Viable product (MVP) - Developing a feasibility prototype with differentiating value, features and benefits - Assess relative market position via competition analysis - Sizing the market and assess scope and potential scale of the opportunity.

Unit 4 **Business & Financial Model, Go-to-Market Plan** **11**

Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build - Measure – Lean approach.
Business planning: components of Business plan- Sales plan, People plan and financial plan.
Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analysing financial performance.
Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy.
Choosing a form of business organization specific to your venture, identifying sources of funds: Debt& Equity, Map the Start-up Life-cycle to Funding Options.

Unit 5 **Scale Outlook and Venture Pitch readiness** **11**

Understand and identify potential and aspiration for scale vis-a-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck.

Prescribed Textbooks:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha .
2. Entrepreneurship, McGrawHill, 11th Edition.(2020)
3. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business,(2011).
4. Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons. (2010).

Reference Books:

1. Simon Sinek,Start with Why, Penguin Books limited. (2011)
2. Brown Tim,Change by Design Revised & Updated: How Design Thinking
3. Transforms Organizations and Inspires Innovation, Harper Business.(2019)
4. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited
5. Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd.

Course Outcomes:

At the end of the course, the student will be able to	Blooms Level of Learning
1. Develop an entrepreneurial mindset and appreciate the concept of entrepreneurship.	L3
2. Comprehend the process of problem-opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution.	L3
3. Analyze and refine business models to ensure sustainability and profitability	L3
4. Build Prototype for Proof of Concept and validate MVP of their practice venture idea.	L4
5. Create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture.	L5

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
23AHS56T-1	-	2	-	2	-	-	3	2	2	2	-	-
23AHSM51T-2	2	3	2	3	2	-	2	-	-	2	-	-
23AHSM51T-3	3	2	3	2	3	-	2	2	-	2	-	-
23AHSM51T-4	2	2	2	2	3	2	3	3	3	3	-	-
23AHSM51T-5	-	-	-	-	2	-	-	2	-	2	-	-