Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati Autonomous

Course Structure & Credit Distribution for

T. Y. B. Sc. (Electronics) (Sem. VI) (2022 Pattern)

(w.e.f. June, 2024)

Course Structure

Semester	Title of Paper		No. of Credits
VI	USEL361	Advanced Communication Techniques	3
	USEL362	Embedded Systems Design	3
	USEL363	Power Electronics	3
	USEL364	Nanoelectronics	3
	USEL365	Mathematical Methods and Circuit Analysis using MATLAB	3
	USEL366	Industrial Automation Systems	3
	USEL367	Practical Course I	2
	USEL368	Practical Course II	2
	USEL369	Project	2

USEL 361: Paper I: Advanced Communication Techniques

SEMESTER: VI | **CREDITS: 3** | **LECTURES: 48**

Objectives:

1. To learn types of antenna
2. Study the wave propagation methods.
3. To learn modulation and demodulation system.
4. To study transmitter and receiver section in communication systems
5. To understand the advanced communication system.
6. To study basic digital communication system.
7. To study mobile communication system.

Course Outcome:

CO1. To Know the working principle of various antenna.
CO2. Student will be able to learn wave propagation techniques
CO3. To know the working principle modulation and demodulation
CO4. Student will be able to learn transmitter and receiver.
CO5. Student will be able to learn advanced communication technologies.
CO6. They will be able to understand various aspects of mobile communication
CO7. Student will be able to learn digital communication technologies

Unit 1: Antenna & Propagation **[13]**

Antenna: Basic consideration Parameters of Antenna, Resonant Antenna- Radiation patterns & length considerations, Non-Resonant antenna, UHF & Microwave antenna, Wide-band & special purpose Antennas, Monopole for MF and HF Applications Monopole at VHF Antenna for Wireless Local Area Network Application

Propagation of Waves: Ground (Surface waves), sky wave propagation, space waves, Tropospheric scatter propagation, Effect of Earth’s Magnetic Field

Unit 2: Modulation & Demodulation **[10]**

Balanced Modulator- Using diodes & FETs, SSBSC- Filter Method, Phase shift method (third method), Synchronous Demodulation, Product Demodulator, Phase modulation & demodulation using PLL

Unit 3: Transmitter & Receiver **[13]**

AM transmitters: Block diagram, FM Transmitters: Using Frequency multiplication & mixing, Frequency stabilized reactance FM transmitter, FM achieved through phase modulation Mobile receiver block diagram (800MHz), Doppler RADAR, Speed Gun, Low noise amplifier block diagram

Unit 4: Digital Communication **[12]**

Block diagram- Digital Communication System, Pulse modulation, Pulse code modulation, Differential Pulse Code Modulation, Delta modulation, Adaptive delta modulation, TDM, FDM

Recommended Books:

1. Electronic Communication By Dennis Roddy & John Coolean, Pearson Education
2. Principles of Communication Systems By Taub Schilling, McGraw Hill.
3. Antenna Theory: Design & Analysis By Balanis, Wiley Eastern
4. Electronic Communication systems By Kennedy & Davis, Tata McGraw Hill
5. Antennas and Wave Propagation By: Harish, A.R.; Sachidananda, M.
6. Mapping of Program Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	3	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	3
CO3	3	-	3	-	-	-	-	-	-
CO4	-	3	3	-	-	-	-	-	-
CO5	-	1	-	2	-	-	-	-	2
CO6	2	3	2	-	2	2	2	-	-
CO7	1	1	-	-	-	3	3	-	-

PO1: Disciplinary Knowledge

CO1: Understanding the working principles of various antennas provides foundational knowledge in communication engineering.

CO3: Knowledge of modulation and demodulation relates to core concepts in electrical engineering and telecommunications.

CO6, 7 Exploring the concept of mobile and digital communication technologies

PO2: Critical Thinking and Problem Solving

CO2: Learning wave propagation techniques requires analytical skills to solve real-world problems related to signal transmission.

CO4: Understanding transmitter and receiver systems encourages critical evaluation of system designs.

CO5-7 required for analysis of mobile and digital communication technologies.

PO3: Social Competence

CO6: Exploring aspects of mobile communication highlights the impact of technology on society and fosters awareness of social issues related to communication.

CO 1,4, 6 explore the knowledge of antenna, transmitter and receiver.

PO4: Research-related Skills and Scientific Temper

CO5: Learning advanced communication technologies can inspire curiosity and drive for research in emerging fields.

PO5: Trans-disciplinary Knowledge

CO6: Mobile communication encompasses knowledge from various disciplines, including computer science, electronics, and social sciences.

PO6: Personal and Professional Competence

CO7: Gaining expertise in advanced communication technologies enhances both personal skills and professional readiness in the field.

PO7: Effective Citizenship and Ethics

CO6: Understanding the implications of mobile communication fosters responsible citizenship and ethical considerations in technology use.

PO9: Self-directed and Life-long Learning

CO2 and CO5: Engaging with wave propagation and advanced technologies encourages students to take initiative in their learning journey beyond the classroom.

USEL 362: Paper II: Embedded System Design

SEMESTER: VI **CREDITS: 3** **LECTURES : 48**

Course Objectives:

1. To introduce basic blocks of embedded systems.
2. Use "C" language for programming the microcontrollers
3. Learn to use Timers, Interrupts and Serial Communication in Microcontroller.
4. Apply skills to conduct interfacing microcontroller boards to various peripherals.
5. Apply the knowledge in real world applications using embedded C.
6. Understand programming basics of python programming language.
7. Write code/program using open-source programming language (Arduino) for basic identified applications.

Course Outcomes:

1. Acquire a basic knowledge about fundamentals of microcontrollers
2. Acquire a basic knowledge about programming and system control to perform a specific task.
3. Acquire knowledge about devices and buses used in embedded networking
4. Develop programming skills in embedded systems for various applications.
5. Knowledge of various SBCs in the market and their comparison.
6. Familiar to Arduino microcontroller board.
7. Learn Arduino IDE and python programming.

Unit 1: Embedded System [14]

Introduction to Embedded Systems, Introduction to PIC and AVR Microcontrollers, 8051 C Programming: Introduction to Embedded C, C data types, C Programs for Time Delays & I/O Operation, I/O Bit Manipulation, Arithmetic and Logical Operations, Timer programming - Timers and counters, delay generation using timer, waveform generation using timer. Serial Port Programming in C.

Unit 2: Designing Embedded Systems using Embedded C Programming [10]

Designing of LED On-Off, SSD, 7-segment,LCD using 8051 microcontroller and Embedded C, Study of interfacing of DAC and ADC using 8051C, Temperature monitoring system using 8051C.

Unit 3: Single Board Computers (SBC) in Embedded System [14]

SBC Block diagram, Types, Comparison of SBC models, Specifications, I/O devices (Storage, Display, Keyboard, Mouse), Network Access Devices. Arduino Microcontroller Board: Introduction to Arduino, Microcontrollers used in Arduino, Pin configuration and architecture, Concept of digital and analog ports. Arduino programming: Introduction to Arduino IDE, variables and data types, Comparison operators (arithmetic, logical and relational, modulo and assignment) Statements: If-Else Statement, Switch statement Control structures: While and For Loop Writing Arduino programs: LED blinking and Push button Serial Port Communication Function blocks: analogRead (), digitalRead () functions Intensity control of LED with Pulse Width Modulation using analogWrite ( ).

Unit 4: Introduction to Python. [10]

Basic Python Programming (Script programming): Variable & data types, Flow Control structures, Conditional statements (If…Then…else), Functions: I/O function (GPIO, Digital), Time functions, Library functions Basic Arithmetic Programs: Addition, Subtraction, Multiplication, and Division.

Table of Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	1							
CO2	3							2	
CO3	2					1			
CO4	3		1		1				
CO5	1						1		
CO6	2								1
CO7	2			2					

<u>Justification for mapping</u>

PO1: Disciplinary Knowledge:

CO1: Acquiring basic knowledge about fundamentals of microcontrollers aligns directly with the goal of demonstrating comprehensive knowledge in the discipline of embedded systems.

CO2: Acquiring basic knowledge about programming and system control for specific tasks is integral to demonstrating a strong theoretical and practical understanding in the area of embedded systems.

CO3: Acquiring knowledge about devices and buses used in embedded networking is crucial for a comprehensive understanding of the discipline in a graduate program focused on embedded systems. CO4: Developing programming skills in embedded systems for various applications directly contributes to the practical understanding and execution of knowledge in the field of embedded systems.

CO5: Knowledge of various Single Board Computers (SBCs) and their comparison, while valuable, is moderately related as it extends slightly beyond the core focus on microcontrollers and embedded systems.

CO6: Being familiar with the Arduino microcontroller board directly aligns with the goal of demonstrating comprehensive knowledge in the discipline of embedded systems.

CO7: Learning Arduino IDE and Python programming enhances the practical understanding of embedded systems and contributes to demonstrating comprehensive knowledge in the discipline.

PO2: Critical Thinking and Problem solving

CO1: Acquiring basic knowledge about fundamentals of microcontrollers contributes to critical thinking and problem-solving skills in the context of embedded systems.

PO3: Social competence

CO4: Developing programming skills in embedded systems is moderately related to social competence, as it enhances technical abilities but may not directly impact interpersonal skills.

PO4: Research-related skills and Scientific temper

CO7: Learning Arduino IDE and Python programming is moderately related to research-related skills, as it contributes technical skills but may not directly involve laboratory techniques or independent experimentation.

PO5: Trans-disciplinary knowledge

CO4: The focus on acquiring knowledge about microcontrollers, programming, embedded networking, and related technical skills

PO6: Personal and professional competence

CO5: Knowledge of various Single Board Computers (SBCs) involves personal competence but may not explicitly address collaboration or interdisciplinary aspects.

PO7: Effective Citizenship and Ethics

CO5: Knowledge of various Single Board Computers (SBCs) in the market involves technical knowledge but may not explicitly address social concern, equity, or ethical considerations.

PO8: Environment and Sustainability

CO2: Acquiring basic knowledge about programming and system control is focused on technical aspects and may not inherently involve considerations of societal and environmental impacts or sustainable development.

PO9: Self-directed and Life-long learning

CO6: Being familiar with the Arduino microcontroller board contributes to foundational skills for self-directed and life-long learning in the context of evolving technology

USEL 363: Paper III: Power Electronics

SEMESTER: VI **CREDITS : 3** **LECTURES : 48**

Learning objectives:

1. To get introduce to basics of power electronics and familiar with Power Electronic Devices, circuits and applications.
2. To get the knowledge of power devices.
3. To study the construction and working of different power devices.
4. To study the switching characteristics of power diodes, BJT, MOSFET, Thyristors.
5. To understand various types of power circuits.
6. To study applications of power electronics.
7. To learn the drives and power supplies.

Note: Scope of the syllabus is limited to single phase circuits.

Course Outcomes: By the end of the course, students will be able to:

CO1: Acquire Knowledge of basics of power electronics.
CO2: Know different power devices.
CO3: Understand power circuits.
CO4: Analyze rectifiers, Regulators, Inverters.
CO5: Learn essentials of switches, controlled rectifiers.
CO6: Analyze waveforms of power circuits.
CO7: Understand the power supplies and motor drives.

Unit 1: Introduction **[6 L]**

Definition of power electronics, Applications of power electronics, classification of power semiconductor devices, ideal and practical characteristics of power devices as a switch, switching power losses, types of Power circuits, Concept of single phase and three phase using phasors.

Unit 2: Power Devices **[14 L]**

Power Diode (P-i-N): construction, Reverse recovery characteristics, diode in series and parallel, Power BJT, power MOSFET, IGBT: Steady state and Switching Characteristic.
Thyristors: Types of Thyristors, SCR characteristics, Two transistor static and transient model, turn-on methods, turn-off characteristics, dv/dt and di/dt protection.

Unit 3: Power Circuits **[18 L]**

Rectifiers: Performance parameters, Half wave, Full wave centre tapped and bridge rectifier,
DC Filters: concept of C, L and LC filters.
Controlled rectifiers: Principle, Semi, Full and Dual Converters.
AC voltage controllers: on-off control, Phase angle control, Bi-directional control with Resistive load,transformer tap changer, Cycloconverter.
Choppers: Step-up, Step-down, concepts of choppers operating in various quadrants
Regulators: Buck and Boost regulators.
Inverters: Performance parameters, principle, Half Bridge and full Bridge inverter.
Switches : DC Switches, Solid state relays, AC Switches and Microelectronic relays.

Unit 4: Power Supplies and Drives **[10 L]**

Power supply (AC, DC): Switch mode DC power supply, flyback converter, Uninterrupted power supply (UPS).

DC motor drives: characteristics, operating modes, dc drives using half wave converter, semi converter, full converter. AC drives: Introduction to Induction and synchronous motor drives.

Recommended Books:-

1. M.H. Rashid Power electronics: Circuits, Devices and Applications, third Edition (2004) Pearson Education.
2. Ned Mohan, undeland, Robbins Power Electronics, Third Edition (2006) John Wiley & Sons.
3. O.P. Arora Power electronics Laboratory: theory , Practice & Organization Narosa Publishing house (2007).
4. P.C. Sen Power Electronics Tata Mc Graw Hill, (1998).

Course Outcomes	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	2	1	2	-	-	3
CO2	3	3	1	2	1	2	-	-	3
CO3	3	3	1	2	2	3	-	2	3
CO4	3	3	1	3	2	3	-	2	3
CO5	3	3	1	2	1	3	-	2	3
CO6	3	3	1	2	2	3	-	2	3
CO7	3	3	1	3	1	3	-	2	3

CO-PO Mapping Justifications:

PO1: Disciplinary Knowledge

CO1: Mastery of basic concepts is fundamental for deepening knowledge in power electronics.

Understanding basic electronic components like resistors and capacitors is crucial for more advanced topics.

CO2: Knowledge of different devices is central to electrical engineering. Understanding various types of transistors and diodes is essential for designing circuits.

CO3: Understanding power circuits is fundamental to electrical engineering. Mastery of series and parallel circuits is essential for advanced circuit design.

CO4: Analyzing these components is key to understanding power electronics. Knowledge of rectifiers and regulators is crucial for designing stable power supplies.

CO5: Understanding switches and controlled rectifiers is fundamental to power electronics. Knowledge of these components is crucial for designing efficient electrical systems.

CO6: Essential for understanding the behavior of power circuits. Analyzing waveforms is crucial for designing and troubleshooting circuits.

CO7: Understanding power supplies and motor drives is fundamental to power electronics. Knowledge of these systems is crucial for designing and implementing power systems.

PO2: Critical Thinking and Problem Solving

CO1: Basic knowledge supports problem-solving in introductory tasks but is less critical for complex issues. Solving simple circuit problems helps in developing analytical skills.

CO2: Selecting appropriate devices requires significant problem-solving and analytical skills. Choosing the right power device for a specific application involves critical analysis.
CO3: Analyzing power circuits requires complex problem-solving and analytical skills. Designing a circuit to meet specific voltage and current requirements involves critical thinking.
CO4: Requires complex problem-solving to analyze and design these components. Designing an efficient inverter involves solving complex electrical problems.
CO5: Analyzing these components requires problem-solving skills to address design and operational issues. Designing controlled rectifiers for specific applications involves critical analysis.
CO6: Requires critical analysis to interpret and solve waveform-related issues. Diagnosing issues in power circuits based on waveform analysis involves complex problem-solving.
CO7: Requires solving complex problems related to power supply design and motor drive systems. Designing a power supply that meets specific requirements involves significant problem-solving.

PO3: Social Competence
CO1 to CO7: Limited impact on social competence or teamwork. And doesn’t directly influence social skills or collaboration.

PO4: Research-related Skills and Scientific Temper
CO1: Provides a foundation for scientific inquiry and experimental skills. Basic understanding helps in setting up simple experiments for research projects.
CO2: Knowledge of devices supports research and experimentation. Research on new semiconductor materials requires understanding different devices.
CO3: Understanding power circuits supports scientific research and experimentation. Research on new power electronics technologies involves detailed circuit analysis.
CO4: Essential for advanced research and development in power electronics. Research on new types of rectifiers or inverters involves detailed analysis and experimentation.
CO5: Provides a basis for research and innovation in power electronics. Research on improving switch performance or controlled rectifier designs involves these basics.
CO6: Supports research by providing insights into circuit behavior. Research on circuit performance often involves waveform analysis.
CO7: Essential for advanced research in power electronics and motor control. Research into improving power supply efficiency and motor drive performance involves detailed study.

PO5: Trans-disciplinary Knowledge
CO1: Minimal immediate impact on other disciplines. Basic concepts are specific to electrical engineering without direct application in other fields.
CO2: Limited immediate application outside electrical engineering. Device knowledge is specialized and doesn’t apply broadly to other disciplines.
CO3: Knowledge of power circuits applies to various engineering disciplines. Circuit principles are relevant in fields such as automation and control systems.
CO4: Relevant in various engineering fields, such as renewable energy and power management.
Inverters are used in solar power systems and other technologies.
CO5: Specific to electrical engineering with limited cross-disciplinary impact. Limited application in fields outside electrical engineering.
CO6: Relevant to other fields that use electronic circuits, such as telecommunications. Waveform analysis is applicable in various engineering disciplines beyond electrical engineering

CO7: Specific to electrical engineering, with limited cross-disciplinary relevance. While relevant to engineering, it has limited application in non-engineering fields.

PO6: Personal and Professional Competence

CO1: Builds foundational competence necessary for professional growth. A strong grasp of basics is crucial for future roles in the industry.
CO2: Proficiency in different devices enhances professional skills. Understanding device characteristics is crucial for professional engineering roles.
CO3: Proficiency in power circuits is crucial for professional success in electronics. Designing and troubleshooting circuits is a key skill for electrical engineers.
CO4: Crucial for developing professional expertise in power electronics. Proficiency in analyzing these components is essential for electrical engineers.
CO5: Essential for developing expertise in power electronics. Mastery of switches and controlled rectifiers is important for professional practice.
CO6: Essential for professional competence in circuit design and analysis. Engineers must be skilled in waveform analysis to design effective circuits.
CO7: Minimal direct impact on ethical considerations or citizenship. The focus on technical knowledge does not address ethical issues directly.

PO8: Environment and Sustainability

CO3: Efficient circuit design can impact energy consumption and sustainability. Designing low-power circuits contributes to energy conservation.
CO4: Design and analysis of these components can impact energy efficiency and sustainability.
Efficient rectifiers and inverters contribute to reduced energy consumption.
CO5: Understanding these components can contribute to sustainable design practices. Efficient switches and rectifiers can improve overall energy efficiency.
CO6: Efficient circuit design based on waveform analysis can contribute to sustainability. Optimizing circuit performance to reduce energy consumption.
CO7: Efficient power supplies and motor drives can contribute to environmental sustainability.
Designing energy-efficient systems helps reduce overall energy consumption.

PO9: Self-directed and Lifelong Learning

CO1: Mastery of basics fosters a strong foundation for lifelong learning. Understanding core concepts enables students to pursue advanced topics independently.
CO2: Understanding devices encourages continuous learning about technological advancements.
Keeping up with new types of power devices requires ongoing education.
CO3: Mastery of power circuits supports lifelong learning and adaptation to new technologies.
Students must continually learn about new circuit designs and technologies.
CO4: Analysis of these components supports ongoing learning and adaptation to new technologies. Staying updated with advancements in rectifiers and inverters is essential for career growth.
CO5: Encourages ongoing learning and adaptation to new technologies. Students need to keep up with advancements in switch and rectifier technologies.
CO6: Encourages ongoing learning and adaptation to new waveform analysis techniques. Students must keep learning about new methods for waveform analysis.
CO7: Promotes ongoing learning about advancements in power supplies and motor drives. Students need to stay updated on new technologies and improvements in power systems.

USEL 364: Paper IV: Nanoelectronics

SEMESTER: VI **CREDITS : 3** **LECTURES : 48**

Course Objectives

1. To understand the fundamental principles of electromagnetics, including the motion of charged particles in electromagnetic fields and the Hall effect.
2. To explore Maxwell's equations and their applications in deriving the wave equation for electric and magnetic fields.
3. To introduce the key concepts of quantum mechanics, including wave-particle duality, the Schrödinger wave equation, and quantum behavior in confined systems like potential wells.
4. To understand various statistical models, including Fermi-Dirac, Bose-Einstein, and Maxwell-Boltzmann distributions, and their relevance to the behavior of electrons in solids and nanostructures.
5. To study the importance of nanoelectronics and the methods used in nanofabrication, such as top-down and bottom-up approaches, and lithography techniques.
6. To gain insights into advanced nanostructure devices like resonant-tunneling diodes, quantum wells, quantum wires, and their applications in nanoelectronics.
7. To connect the theoretical aspects of electromagnetics, quantum mechanics, and statistical mechanics with the practical applications in nanoelectronic devices and technologies.

Course Outcomes

CO1. Students will be able to understand the motion of charged particles in electromagnetic fields, calculate cyclotron frequency, and explain the Hall effect.

CO2. Students will be able to apply Maxwell's equations to derive wave equations for electric and magnetic fields, and use the Poynting vector theorem to analyze energy flow in electromagnetic systems.

CO3. Students will be able to comprehend quantum mechanical concepts like wave-particle duality, the Schrödinger equation, and the behavior of particles in confined quantum systems such as potential wells.

CO4. Students will be able to describe different statistical distributions (Fermi-Dirac, Bose-Einstein, Maxwell-Boltzmann) and their applications in modeling electron behavior in solids and nanostructures.

CO5. Students will be able to explain the significance of nanoelectronics and differentiate between the top-down and bottom-up approaches used in the fabrication of nanoscale devices.

CO6. Students will be able to analyze and describe the operation of advanced nanostructure devices, including resonant-tunneling diodes, quantum wells, quantum wires, and quantum dots.

CO7. Students will be able to relate theoretical principles from electromagnetics, quantum mechanics, and statistical mechanics to the design and analysis of nanoelectronic devices and applications.

Unit 1: Essential Electromagnetics [12]

Lorentz force-Motion of charged particle in E-M fields, cyclotron frequency, Hall effect, Maxwell's equations, Equation of continuity, Poynting vector theorem, Wave equation for E and H,
Skin depth.

Unit 2: Quantum mechanical aspects [12]

Particles and Waves: Classical particles, Light as wave and particle, Wave particle duality and Uncertainty principle, Wave mechanics: The Schrödinger wave equation, wave mechanics of particles, Infinite potential well.

Unit 3: Introduction to Statistical aspects [12]

Classical statistics, Gaussian distribution, Poisson distribution, Fermi-Dirac, Bose Einstein, Maxwell Boltzmann statistics, Time and length scales of the electrons in solids, statistics of electrons in solids and nanostructures, Density of states of electrons, electron transport.

Unit 4: Nano electronics [12]

Importance of nanoelectronics, Top down approach, Bottom up approach, Lithography, Nanostructure devices like resonant- tunneling diode, electrons in quantum wells, electrons in quantum wire, Quantum dot applications.

Recommended Books:

1. George W. Hanson "Fundamentals of nanoelectronics", LPE, Pearson Education
V. Mitin ,Viatcheslav A. Kochelap , Michael A. Stroscio Vladimir

2. "Introduction to Nano electronics Science ,nanotechnology , Engineering and Applications"Cambridge University Press 2008
3. Ben G. Streetman ,Sanjaykumar Banerjee "Solid State Electronic Devices ", 6th Edition
4. Kraus and Fleisch "Electromagnetics with applications" McGraw Hill, 5th edition
5. Electromagnetics by B.B. Laud, Wiley Edition
6. Donald A.Neaman, "Semiconductor Physics and devices" 3rd edition TMH

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	-	-	-	1	-	-	-	3
CO2	-	3	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-
CO4	-	-	2	-	-	3	-	2	-
CO5	-	-	-	-	-	-	1	-	-
CO6	2	-	-	-	-	-	-	-	-
CO7	-	-	-	-	-	-	-	-	-

PO1: Disciplinary Knowledge

CO1 : Strongly related as understanding the motion of charged particles, calculating cyclotron frequency, and explaining the Hall effect requires in-depth disciplinary knowledge in electromagnetism.

CO6 : Strongly related because analyzing advanced nanostructure devices involves deep knowledge in nanotechnology and semiconductor physics.

PO2: Critical Thinking and Problem Solving

CO2 : Strongly related as applying Maxwell's equations and the Poynting vector theorem requires critical thinking and problem-solving skills to analyze electromagnetic systems.

PO3: Modern Tool Usage

CO4 : Moderately related as describing statistical distributions and their applications involves using modern theoretical tools, though it is less focused on physical tools or technologies.

PO4: Research-related Skills and Scientific Temper

CO2 : Strongly related because applying Maxwell's equations and analyzing energy flow in electromagnetic systems involve research skills and a scientific approach to problem-solving.

PO5: Trans-disciplinary Knowledge

CO1 : Strongly related as understanding the motion of charged particles and related effects integrates knowledge from multiple scientific disciplines, including physics and engineering.

PO6: Individual and Team Work

CO4 : Moderately related as describing statistical distributions and their applications involves both individual understanding and the potential for teamwork in research or academic settings.

PO7: Innovation, Employability, and Entrepreneurial Skills

CO5 : Strongly related as explaining nanoelectronics and fabrication approaches supports innovative thinking and understanding emerging technologies crucial for employability and entrepreneurship.

PO8: Environment and Sustainability

CO4 : Partially related as describing statistical distributions mainly focuses on theoretical aspects with limited direct emphasis on environmental or sustainability issues.

PO9: Self-Directed and Lifelong Learning

CO1 : Strongly related as understanding the motion of charged particles and related concepts requires ongoing self-directed learning and a commitment to lifelong education in advanced topics.

USEL 365: Paper V

Mathematical Methods and Circuit Analysis using MATLAB

SEMESTER: VI **CREDITS : 3** **LECTURES : 48**

Course Objectives:

1. To learn features of MATLAB as a programming tool.
2. To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
3. To understand Laplace Transform and Fourier series and its applications.
4. To use MATLAB as a simulation tool.
5. To impart practical working knowledge of Electrical and Electronics Simulation and Analysis using Mathematical computing languages such as MATLAB and/or SCILAB.
6. To Solve, Simulate and Analyse basic Electrical and Electronics Circuits and Applications.
7. To develop hands on working experience with reference to Solve, Simulate and Analyse Electrical & Electronics Circuits using MATLAB environments

Course Outcomes:

CO1: Understand the main features and importance of the MATLAB mathematical programming environment.
CO2: Apply working knowledge of MATLAB package to simulate and solve Electrical, Electronics circuits and Applications.
CO3: Solve, Simulate and Analyse various DC circuits.
CO4: Solve, Simulate and Analyse various AC circuits.
CO5: Solve, Simulate and Analyse various Analog and Digital Electronics circuits.
CO6: Solve, Simulate and Analyse simple Transformer and DC Generator circuits.
CO7: Analyze the generation Various Signals and Sequences in MATLAB, including the operations on Signals and Sequences

Unit-1: Basics of MATLAB **[14]**

MATLAB windows, working in command window, display formats, Built in function, mathematical operations with array, Array-1D, 2D & Script files, 2D & 3D plots. Function and function files, file handling.

MATLAB Programming: -Conditional statement, Switch-case statement, loops, nested loops, break & continue statement.

Unit-2: Laplace Transform and its applications **[14]**

Definition, Laplace transform of simple functions, properties of L.T. (Linearity, shifting, change of scale), Inverse L.T., Partial fraction technique to find inverse L.T.function

Applications: Series RC circuit, RL circuit, RLC circuit for dc input.

MATLAB Exercises**:** 1.To find Laplace Transform and Inverse LT of any given function.
2. Transient analysis of RC / RL/RLC (series) circuit

Unit-3: Modelling and Simulation **[10]**

Introduction, Need, types, steps of modelling, classification of models, Equivalent circuits and mathematical models of circuit elements, simulation concept and illustrative examples.

Unit-4. Mathematical Applications using SIMULINK **[10]**

Curve fitting(Straight line, Exponential) and its application to

1. Diode characteristics
2. Ohm’s Law
3. RC Filter

Running a simulation and analyze the results.

Recommended Books:

1. Amos Gilat MATLAB : An introduction with applications Wiley India
2. G K Mittal Network Analysis Khanna Publishers , New Delhi
3. Van Valkenberg Network Analysis, 3rd Edition Dorling Kindersley (India) Pvt Ltd
4. Umesh Sinha Network Analysis and Synthesis Satya Prakashan, Delhi.
5. RudraPratap Getting Started with MATLAB , 7th Edition Oxford University Press, N Delhi
6. Stephen J. Chapman MATLAB Programming For Engineers. Thomas Learning

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	1	-	-	-	-	-	-	-	-
CO2	-	-	-	3	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-
CO6	-	3	-	-	-	-	-	-	-
CO7	-	-	-	3	-	-	-	-	1

PO1: Disciplinary Knowledge:

CO1: This CO aligns with disciplinary knowledge as it focuses on understanding the main features of MATLAB, which is an essential tool in various engineering disciplines.

PO2: Critical thinking and problem-solving:

CO3: Solving and analyzing DC circuits require critical thinking and problem-solving skills, aligning with the corresponding program outcome.

CO4: Similar to CO3, this CO also aligns with critical thinking and problem-solving skills, specifically in the context of AC circuits.

CO5: The ability to solve, simulate, and analyze analog and digital electronics circuits requires critical thinking and problem-solving skills, aligning with PO2.

CO6: This CO aligns with critical thinking and problem-solving skills, particularly in the context of transformer and DC generator circuits.

PO4: Research-related skills and scientific temper:

CO2: The use of MATLAB for simulation and problem-solving enhances research-related skills and scientific temper by encouraging students to apply a systematic approach in solving electrical and electronics circuit problems.

CO7: Analyzing signal generation and sequences in MATLAB involves research-related skills and encourages self-directed learning, aligning with PO4.

PO9: Self-directed and life-long learning:

CO7: Analyzing signal generation and sequences in MATLAB involves research-related skills and encourages self-directed learning, aligning with PO9.

USEL 366: Paper VI: Industrial Automation

SEMESTER: VI **CREDITS : 3** **LECTURES : 48**

Course objectives:

1. To learn working principle and specification of different sensors.
2. To study Data Acquisition System.
3. To study Process control system and Process Characteristics.
4. To know the different controller modes.
5. To understand automation technologies and identify advantages, limitations and applications of the same.
6. To develop ability to recognize, articulate and solve industrial problems using automation technologies.
7. To understand various automation tools and methods in manufacturing industry.

Course outcomes:

1. To learn working principle and specification of different sensors.
2. To study Data Acquisition System.
3. To study Process control system and Process Characteristics.
4. To know the different controller modes.
5. To understand automation technologies and identify advantages, limitations and applications of the same.
6. To develop ability to recognize, articulate and solve industrial problems using automation technologies.
7. To understand various automation tools and methods in manufacturing industry.

Unit-1: Generalized configuration and performance characteristics of instrumentation system : Functional Elements of an instrument, Analog and Digital Modes of Operation, Null and Deflection Methods, Input Output configuration of Instruments and measuring systems. **[6]**

Unit-2: Study Of Sensors : **[6]**

Working principle and specification of

i) Thermal sensors: Thermistor, Thermocouple
ii) Optical sensors: Photodetector, Optical encoder
iii) Mechanical sensor: LVDT
iv) Magnetic sensor: Hall effect.

Unit 3 :Manipulating, Computing and Compensating devices **[10]**

Instrumentation Amplifiers with three op-amps, Transconductance and Transimpedance Amplifiers, Noise Problems, Shielding and Grounding. Generalized Data Acquisition system-Elements of a data acquisition system, Single channel Data Acquisition system, Multichannel Data Acquisition system,

Unit 4: Fundamentals of Process automation **[13]**

Process control system: Continuous control, discrete state control, composite discrete/continuous control.

Ladder Diagram: Ladder diagram elements with examples.

Process Characteristics: Process equation, Process load, Process lag, self regulation.
Control system parameters: Error, Variable range, control parameter range, control lag, dead time, cycling.

Unit 5: Controller modes [13]

Discontinuous controller modes: Two position mode, Multiposition mode, floating control mode.
Continuous controller modes: Proportional control, Integral control, Derivative control and composite control modes
Proportional-Integral, Proportional derivative, Three mode controller (PID).

Recommended Books:

1. C.D. Johnson, Process control Instrumentation Technology John Willy and Sons, Inc., 3rd Edition
2. C S Rangan, G R Sarma, V S Mani: Instrumentation Devices & Systems, 2nd Edition TMH
3. Ernest O Doebelin, Dhanesh N Manik: Measurement Systems Application and Design ,5th Edition Tata McGraw Hill
4. Joseph J. Carr: Elements of Electronic Instrumentation and Measurement, 3rd Edition, Pearson Education
5. H S Kalsi: Electronic Instrumentation, Second edition, Tata McGraw Hill Pub.

Mapping of Program Outcomes with Course Outcomes

Weightage: 1=Weak or low relation, 2=Moderate or partial relation, 3=Strong or direct relation

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	-	-	-	3	-	-	-	-	-
CO2	-	-	-	2	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-
CO4	-	-	-	1	-	-	-	-	-
CO5	**3**	-	-	-	-	-	-	-	-
CO6	-	**3**	-	-	-	-	-	-	-
CO7	**2**	-	-	-	-	-	-	-	-

Justification For The Mapping

PO1: Disciplinary Knowledge

CO5: As it involves understanding the discipline of automation technologies.

CO7: As it involves understanding the tools and methods specific to the discipline of automation in manufacturing.

PO2: Critical thinking and problem solving

CO3: As studying process control systems involves critical analysis and problem-solving skills.

CO6: As solving industrial problems with automation technologies requires critical thinking.

PO4: research related skills and scientific temper

- **CO1:** As understanding sensor principles involves scientific knowledge and research skills.
- **CO2:** As studying data acquisition systems requires a scientific approach and research skills.
- **CO4:** since understanding controller modes involves scientific knowledge and research skills.

USEL 367: Paper VII: Practical Course- I

There are 10 Experiments in Paper VII ELE367 : Practical Course- I
One activity as directed in practical course which will be equivalent to 2 experiments

Internal Practical Examination (Out of 40)

. 32 Marks to Experiments, 08 Marks to Activity

Semester Practical Examination (Out of 60)

. One experiment - 3 hours duration (60 Marks)
44 Marks to Experiment, 16 marks to activity

Course Objective:-

1. To study and understand the characteristics of transducers and controllers used in industrial automation systems, such as LVDT and capacitive transducers.
2. To provide hands-on experience in designing and implementing basic circuits such as Wheatstone's bridge for resistive transducers and ON-OFF controllers using microcontrollers or operational amplifiers.
3. To explore advanced communication techniques through practical applications of FM and FSK modulation and demodulation, as well as time-division multiplexing and single-sideband (SSB) generation.
4. To familiarize students with power electronics components like SCR, MOSFET, and IGBT, and their applications in circuits such as light dimmers, fan regulators, and PWM-based motor control.
5. To provide practical exposure to the fundamentals of fiber optics, including bending losses, numerical aperture measurements, and fiber optics as sensors.
6. To gain real-world insights into fiber optic communication systems through visits to telecom facilities and learning key processes like splicing, alignment, fusing, and OTDR operations.
7. To engage in activities like industrial visits, hands-on workshops, or open-ended DIY projects to enhance practical knowledge and problem-solving skills in electronics and communication.

Course Outcomes

CO1. Students will be able to measure and analyze the characteristics of LVDT and capacitive transducers and design ON-OFF controllers for industrial automation systems.

CO2. Students will be able to design and test circuits like Wheatstone's bridge for resistive transducers and implement ON-OFF controllers using microcontrollers or operational amplifiers.

CO3. Students will be able to implement advanced communication systems by designing FM and FSK modulators and demodulators, and SSB generation and demodulation circuits.

CO4. Students will be able to analyze the static characteristics of power electronics devices like SCR, MOSFET, and IGBT, and design circuits such as light dimmers, fan regulators, and PWM motor control systems.

CO5. Students will be able to measure bending loss, calculate numerical aperture, and understand the use of optical fibers in sensor applications through hands-on experiments.

CO6. Students will be able to apply knowledge gained from telecom facility visits, observing and understanding key processes like splicing, fusing, OTDR operations, and fiber optic connectorization.

CO7. Students will be able to enhance their practical skills and industrial exposure through participation in activities like industrial visits, workshops, or by developing and presenting their own open-ended projects.

LABORATORY EXPERIMENTS (Total 8 experiments)

Group A: Industrial Automation Systems. (Any two)

1. LVDT Characteristics- Sensitivity measurement.
2. Level measurement using capacitive transducers.
3. Design of Wheatstone's bridge for resistive transducer.
4. ON-OFF controller using microcontroller/op amp.

Group B: Advanced Communication Techniques. (Any two)

1. FM modulator using VCO.
2. FSK modulator and demodulator using XR 2206 and XR2211.
3. Time division multiplexer (IC CD 4051).
4. SSB generation using IC 1496/1596 or equivalent and demodulation.

Group C: Power Electronics (Any two)

1. SCR/MOSFET/IGBT static characteristics.
2. Light Dimmer / fan regulator circuit.
3. PWM based PMDC motor control.
4. Study of SMPS.

Group D: Fiber Optics and fiber optic Communication (Any two)

1. Study of bending loss in fibers.
2. Fiber in sensor application.
3. Measurement of Numerical Aperture.
4. Visit to telecom facility for observing splicing, alignment, fusing, OTDR operation,connectorization, types of connectors, couplers and cables.

Group E: ACTIVITY (Any one activity will be considered as equivalent to 2 experiments.)

1. Industrial visit.
2. Hands on training Workshop.
3. Do it Yourself Open ended Project

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	3	-	3	-	-	-	-	3
CO2	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-
CO4	-	-	2	-	-	3	-	2	-
CO5	-	-	-	-	-	-	1	-	-
CO6	-	-	-	-	2	-	-	-	-
CO7	-	-	-	-	-	-	-	-	-

PO1: Disciplinary Knowledge

CO1 : Strongly related as measuring and analyzing characteristics of LVDT and capacitive transducers and designing ON-OFF controllers requires detailed disciplinary knowledge in instrumentation and control systems.

PO2: Critical Thinking and Problem Solving

CO1 : Strongly related because measuring and analyzing transducers and designing controllers involves critical thinking and problem-solving skills to address complex industrial automation challenges.

PO3: Modern Tool Usage

CO4 : Strongly related as analyzing static characteristics of power electronics devices and designing circuits involves using modern tools and technologies to develop practical electronic solutions.

PO4: Research-related Skills and Scientific Temper

CO1 : Strongly related because measuring and analyzing transducers and designing controllers involves research skills and a scientific approach to understanding and solving technical problems.

CO3 (3): Strongly related as implementing advanced communication systems by designing modulators and demodulators requires research skills and a scientific approach to develop and test communication technologies.

PO5: Trans-disciplinary Knowledge

CO6 : Strongly related as applying knowledge from telecom facility visits integrates insights from various disciplines related to fiber optics and telecommunications.

PO6: Individual and Team Work

CO4 : Moderately related as analyzing power electronics devices and designing circuits involves both individual skills and potential teamwork in practical projects or lab settings.

PO7: Innovation, Employability, and Entrepreneurial Skills

CO5 : Moderately related as measuring bending loss, calculating numerical aperture, and understanding optical fibers through hands-on experiments support innovation and employability but are less directly linked to entrepreneurial skills.

PO8: Environment and Sustainability

CO4 : Partially related as analyzing power electronics devices and designing circuits has limited direct emphasis on environmental sustainability issues.

PO9: Self-Directed and Lifelong Learning

CO1 : Strongly related because measuring and analyzing transducers and designing controllers requires continuous self-directed learning and ongoing development of technical skills.

T.Y. B.Sc. (Electronic Science)

USEL 368: Paper VII: Practical Course- II

---- There are 10 Experiments in Paper VII ELE368 : Practical Course- II

One activity as directed in practical course which will be equivalent to 2 experiments

Internal Practical Examination (Out of 40)

· 32 Marks to Experiments, 08 Marks to Activity

Semester Practical Examination (Out of 60)

· One experiment - 3 hours duration (60 Marks)

· 44 Marks to Experiment, 16 marks to activity

Course Objectives:

1. To learn the C-Programming.
2. To learn MATLAB to design basic circuits.
3. To get familiar with recursion by using C programming.
4. To get familiar with circuit analysis by using Matlab.
5. To learn interfacing of different devices and embedded C language of 8051 microcontroller.
6. To understand C graphics commands.
7. To get introduce different peripherals for microcontroller interfacing.

Course Outcomes: By the end of the course, students will be able to:

CO1: Design and develop C program.
CO2: Demonstrate C graphics program.
CO3: Develop and simulate the circuit using MATLAB.
CO4: Design and develop 8051 microcontroller based systems.
CO5: Inculcate basic skills required for design and development of embedded systems.
CO6: Use different software and hardware for testing and simulation for given problem.
CO7: Demonstrate how to interface 8051 microcontroller with different peripherals.

Total 8 Experiments

Group A: Microcontroller Programming (Any 4)

1. Interfacing LCD.
2. Interfacing SSDs.
3. Interfacing LED Bank.
4. Interfacing DAC- Waveform generator (Ramp, Triangular, square)
5. Traffic Light Controller.
6. Interfacing ADC.

Group B: C Programming / MATLAB (Any 4)

1. Calculate sin and cos by Taylor's series using 'C'.

2. Recursive functions - Factorial of a number, Fibonocci Series using C.
3. Prime numbers generation using C.
4. Draw basic shapes using C graphics commands.
5. Plotting of square and sine waveform using MATLAB.
6. Diode characteristic curve at different temperatures using MATLAB.

Group D: ACTIVITY (Any one activity will be considered as equivalent to 2 experiments.)

1. Circuit Design and simulation using multisim/PSPICE/Proteus.
2. Industrial /field Visit.
3. Hands on training Workshop.
4. Internet browsing
5. Do it Yourself Open ended Project.

Course Outcome	Program Outcome								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	2	3	1	2	-	1	3
CO2	3	3	2	3	1	2	-	1	3
CO3	3	3	2	3	1	2	-	1	3
CO4	3	3	2	3	1	2	-	1	3
CO5	3	3	2	3	1	2	-	1	3
CO6	3	3	2	3	1	2	-	1	3
CO7	3	3	2	3	1	2	-	1	3

Justification For The Mapping

PO1: Disciplinary Knowledge

CO1: Cultivated by designing and developing C programs, providing a fundamental skill in the discipline of computer science and programming.

CO2:Expanded by demonstrating C graphics programs, contributing to a specialized understanding of graphical programming within the broader field of computer science.

CO3:Enhanced by developing and simulating circuits using MATLAB, integrating programming skills into engineering applications, and deepening the understanding of both disciplines.

CO4: Advanced by designing and developing 8051 microcontroller-based systems, integrating knowledge of microcontrollers and embedded systems within the discipline of electrical and electronics engineering.

CO5: Fostered by inculcating basic skills for embedded systems design and development, providing a foundational understanding within the field of electrical and electronics engineering.

CO6: Broadened by using diverse software and hardware for testing and simulation, allowing for a versatile approach to problem-solving within the domains of computer science and engineering.

CO7: Applied by demonstrating the interfacing of an 8051 microcontroller with peripherals, integrating knowledge of microcontrollers and expanding expertise within the discipline of electrical and electronics engineering.

PO2: Critical Thinking and Problem solving

CO1: Developed by designing and developing C programs, requiring logical thinking and algorithmic problem-solving within the realm of computer programming.

CO2: Honed by demonstrating C graphics programs, fostering the ability to address complex graphical challenges and devise effective solutions using programming.

CO3: Cultivated by developing and simulating circuits in MATLAB, demanding analytical thinking and problem-solving capabilities for effective circuit design and simulation.

CO4: Advanced by designing and developing 8051 microcontroller-based systems, necessitating the ability to address challenges in embedded systems design and programming.
CO5: Fostered by instilling basic skills for embedded systems design, encouraging the application of logical reasoning to address challenges in the development of embedded systems.
CO6: Broadened by using diverse software and hardware for testing and simulation, requiring adaptability and analytical thinking in selecting the most suitable tools for problem-solving.
CO7: Applied by demonstrating the interfacing of an 8051 microcontroller with peripherals, showcasing the ability to address challenges in hardware-software integration and peripheral interfacing.

PO3: Social competence

CO1: Collaborative learning and sharing of C programming knowledge, fostering effective communication and teamwork within the programming community.
CO2: Demonstrating C graphics programs, promoting effective communication of complex graphical concepts and encouraging knowledge-sharing within the programming community.
CO3: Collaborating on circuit development and simulation using MATLAB, facilitating effective teamwork and communication in multidisciplinary projects involving both programming and engineering disciplines.
CO4: Promoting collaboration and effective communication in interdisciplinary projects involving hardware and software integration.
CO5: Inculcating basic skills for embedded systems design, encouraging effective communication and collaboration in teams working on projects related to embedded systems development.
CO6: Using various software and hardware tools for testing and simulation, promoting effective communication and collaboration in diverse teams working on problem-solving projects.
CO7: Demonstrating the interfacing of an 8051 microcontroller with peripherals, fostering effective communication and collaboration in multidisciplinary projects involving microcontroller-based systems and peripheral integration.

PO4: Research-related skills and Scientific temper

CO1: Fostered by the design and development of C programs, encouraging students to approach programming challenges with a systematic and research-oriented mindset.
CO2: Honed through the demonstration of C graphics programs, promoting the exploration of innovative graphical techniques and fostering a curiosity-driven approach to programming.
CO3: Cultivated by developing and simulating circuits using MATLAB, instilling a scientific approach and analytical mindset for systematic exploration and experimentation in circuit design.
CO4: Advanced by designing and developing 8051 microcontroller-based systems, encouraging students to approach embedded system design with a research-oriented and analytical mindset.
CO5: Instilled by inculcating basic skills for embedded systems design, promoting a foundational understanding and encouraging students to explore innovative solutions in this field.
CO6: Broadened by using various software and hardware tools for testing and simulation, promoting a research-oriented and analytical approach in problem-solving scenarios.
CO7: Applied by demonstrating the interfacing of an 8051 microcontroller with peripherals, encouraging a systematic and research-oriented approach to exploring hardware-software integration and peripheral interfacing.

PO5: Trans-disciplinary knowledge

CO1: Initiated through the design and development of C programs, fostering a skill set that transcends specific disciplines and can be applied in various contexts beyond programming.
CO2: Demonstrating C graphics programs, showcasing skills applicable not only in computer science but also in fields where graphical programming is relevant, such as multimedia and simulation.
CO3: Integrating programming skills with engineering applications, fostering versatility in problem-solving across disciplines.
CO4: Designing and developing 8051 microcontroller-based systems, bridging computer science and electrical engineering, and providing insights applicable in the broader field of embedded systems.
CO5: Instilling basic skills for embedded systems design, preparing students to apply their knowledge in diverse fields where embedded systems play a crucial role, such as IoT and automation.
CO6: Broadened by using various software and hardware tools for testing and simulation, encouraging adaptability in problem-solving across different domains that require a mix of hardware and software skills.
CO7: Demonstrating the interfacing of an 8051 microcontroller with peripherals, showcasing the integration of hardware and software skills that can be valuable in diverse technological applications beyond microcontroller interfacing.

PO6: Personal and professional competence

CO1: Cultivated by designing and developing C programs, enhancing programming skills that are essential for personal growth and professional success in software development.
CO2: Demonstrating C graphics programs, showcasing creativity and proficiency in graphics programming, contributing to a well-rounded skill set in the professional domain.
CO3: Cultivated through the development and simulation of circuits using MATLAB, combining programming and engineering skills, and promoting versatility for tackling complex problems.
CO4: Designing and developing 8051 microcontroller-based systems, requiring a combination of hardware and software skills crucial for success in the field of embedded systems.
CO5: Inculcating basic skills for embedded systems design, enabling individuals to contribute effectively to the development of embedded systems, aligning with professional competency.
CO6: Using various software and hardware tools for testing and simulation, enhancing adaptability and problem-solving skills essential for professional growth.
CO7: Demonstrating the interfacing of an 8051 microcontroller with peripherals, showcasing proficiency in hardware-software integration, a valuable skill in the professional landscape.

PO8: Environment and Sustainability

CO1: Promoting the efficient design of C programs, encouraging practices that optimize resource utilization and contribute to the sustainability of software development environments.
CO2: Encouraging the development of visually engaging content with a focus on minimizing environmental impact through efficient programming practices.
CO3: Using MATLAB for circuit development and simulation, as virtual simulations reduce the need for physical prototypes, contributing to resource conservation and sustainable engineering practices.
CO4: Emphasizing energy efficiency, and environmentally conscious practices in the development of embedded systems.
CO5: Promoting basic skills for embedded systems design, fostering an understanding of energy-efficient and environmentally friendly practices in the development of embedded technologies.

CO6: Choosing software and hardware tools for testing and simulation that minimize environmental impact, aligning with sustainable practices in technology development.
CO7: Demonstrating the interfacing of an 8051 microcontroller with peripherals, emphasizing the importance of energy-efficient and environmentally conscious design in hardware-software integration practices.

PO9: Self-directed and Life-long learning

CO1: Encouraging students to independently explore and enhance their C programming skills, fostering a mindset of continuous learning in the field of software development.
CO2: Motivating students to independently explore advanced graphics techniques and cultivate a commitment to lifelong improvement in programming skills.
CO3: Involving students in the development and simulation of circuits using MATLAB, fostering a sense of curiosity and a commitment to continuous learning in the domain of electrical engineering and simulation tools.
CO4: Engaging students in the design and development of 8051 microcontroller-based systems, encouraging independent exploration and continuous learning in the field of embedded systems.
CO5: Inculcating basic skills for embedded systems design, motivating students to independently pursue further knowledge and skills in the dynamic and evolving field of embedded systems.
CO6: Encouraging students to independently explore various software and hardware tools for testing and simulation, fostering adaptability and a commitment to lifelong learning in problem-solving.
CO7: Motivating students to independently explore and enhance their knowledge in hardware-software integration, fostering lifelong learning in the realm of microcontroller interfacing.

Paper IX : Semester VI

USEL 369: Project

Course Objectives:
Application of the knowledge/concepts acquired in the lower semesters to create/design/implement project relevant to the field of Electronics.

Course Outcomes: By the end of the course, students will be able to:
CO1: Create/Design the project.
CO2: Implement/Simulate/Test and deploy the project application.
CO3: Present and defend the project relevance/creation/design/implementation/simulation
CO4: Present and defend the /design/implementation/simulation of Poject
CO5: Create Design idea and team work.
CO6: Prepare Demonstration of project
CO7: Prepare project report in a standard format

Guideline to conduct Practical Course III
Practical Course III is a project work of 100 Marks.
- Internal project Examination (Out of 40)
- Semester project Examination (Out of 60)

The project work should be followed with following guidelines.
a) In CBCS Pattern, Student has to perform project in Semester V as well as Semester VI.

b) There should be internal continuous assessment of Project work in the form of Seminars/presentation and continuous monitoring of work.

c) After completion of project, student has to submit the Project Report in the following format.

i. Title of Project

ii. Aim and objectives of project.

iii. Literature or Reference work

iv. Block diagram and its explanation in brief and/or algorithm of software required if any

v. Design and development of Circuit/system and Simulation required if any

vi. Circuit Diagram and its working and Program explanation if any

vii. Experimental Work and PCB Design/fabrication required if any

viii. Results and Discussion
ix. Applications

x. Future Scope

xi. References

d. Further extension work may be suggested for better outcome of the project.
e. It is recommended to present the projects in competitions / project exhibitions organized by various authorities

Course Outcome	Program Outcome								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-		2	-	-	-	2
CO2	-	-	-	3	-	-	-	-	3
CO3	-	-	-	-	-	2	2	2	-
CO4	-	-	-	-	-	3	3	-	-
CO5	3	-	3	-	3	-	-	-	-
CO6	-	-	-	2	-	-	-	2	-
CO7	-	-	-	-	-	2	2	-	2

PO1: Disciplinary Knowledge

CO1: Creating/designing a project involves applying foundational knowledge in the relevant discipline.

CO5: Designing ideas and collaborating in a team enhances understanding of disciplinary concepts.

PO2: Critical Thinking and Problem Solving

CO2**:** Implementing, simulating, testing, and deploying the project requires critical analysis and problem-solving skills.

CO3: Presenting and defending project relevance necessitates evaluating various solutions and articulating rationale.

PO3: Social Competence

CO5: Teamwork in project design promotes collaboration and communication skills essential for social competence.

PO4: Research-related Skills and Scientific Temper

CO2: Testing and deploying applications can foster a scientific approach to research and experimentation.

CO6: Preparing demonstrations of projects encourages the application of research skills to communicate findings effectively.

PO5: Trans-disciplinary Knowledge

CO1 and CO5: Creating and designing projects often draw from multiple disciplines, enhancing trans-disciplinary understanding.

PO6: Personal and Professional Competence

CO3 and CO4**:** Presenting and defending project aspects develops confidence and professional communication skills.

CO7: Preparing project reports in a standard format helps cultivate professional writing and documentation skills.

PO7: Effective Citizenship and Ethics

CO3**:** Defending project relevance involves ethical considerations in design and implementation.

CO6**:** Demonstrations can reflect responsible use of technology in society.

PO9: Self-directed and Life-long Learning

CO1 and CO2: Engaging in project creation and deployment encourages students to pursue knowledge and skills independently.

CO7: Preparing reports fosters an understanding of standards and practices, promoting lifelong learning.