Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Academic Year 2021-2022

T.Y.B.Sc. Electronic Science

To be implemented from Nov/Dec. 2021

Course Structure

Semester	Paper Code	Title of Paper	No. of Credits
VI	ELE3601	Advanced Communication Systems	3
	ELE3602	Embedded Systems and Programming	3
	ELE3603	Power Devices and Circuits	3
	ELE3604	Foundation of Nanoelectronics	3
	ELE3605	Mathematical Methods and Circuit Simulation using MATLAB	3
	ELE3606	Industrial Automation	3
	ELE3607	Practical Course I	2
	ELE3608	Practical Course II	2
	ELE3609	Practical Course III (Project)	2

Question paper : Theory -
- **For Internal Examination 40 Marks**
- **For Semester Examination 60 Marks**

Practical -
- **For Internal Examination 40 Marks**
- **For Semester Examination 60 Marks**

ELE3601: Paper I: Advanced Communication Systems

SEMESTER: VI CREDITS : 3 LECTURES : 48

Course Objectives:

1. To study basics of communication systems.
2. To understand telephone system.
3. To understand Amplitude Modulation.
4. To understand Antenna and propagation.
5. To understand Frequency Modulation.
6. To understand demodulation techniques.
7. To learn the Digital communication system.

Course Outcomes:

CO1: Understand and identify the fundamental concepts and various components of communication systems.
CO2: Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.
CO3: Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.
CO4: Define the need of modulation for communication systems.
CO5: Explain the behavior of the communication systems in the presence of noise.
CO6: Compare the different analog and digital modulation schemes for transmission of information.
CO7: Calculate the bit error rate for different digital modulation schemes.

Unit 1: Antenna & Propagation [14]

Antenna**:** Basic consideration Parameters of Antenna, Resonant Antenna- Radiation patterns & length considerations, Non-Resonant antenna, UHF & Microwave antenna, Wide-band & special purpose antennas
Propagation of Waves**:** Ground (Surface waves), sky wave propagation, space waves, Tropospheric scatter propagation.

Unit 2: Modulation & Demodulation [12]

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 [12]

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 [10]

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

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

Mapping of Program Outcomes with Course Outcomes

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

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

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PO1: Computer knowledge:

CO3: Developing the ability to compare and contrast communication systems involves accessing and utilizing various resources, possibly through online databases, simulations, or analytical tools.

CO6: Students comparing modulation schemes may involve using computer simulations to evaluate their performance under various conditions. Computer knowledge is essential for conducting these comparisons efficiently and accurately.

CO7: Students are able to calculating the bit error rate often involves complex mathematical models and simulations. Computer knowledge is needed for using computational tools to perform these calculations and analyze the performance of digital modulation schemes.

PO2: Design/ development of a solution:

CO1: Understanding the fundamental concepts and components of communication systems lays the groundwork for designing solutions in communication engineering. This knowledge is essential for creating effective and efficient communication solutions.

CO2: Explaining signal-to-noise ratio, noise figure, and noise temperature involves understanding the impact of noise in communication systems. This knowledge is crucial for designing solutions that minimize the effects of noise and optimize system performance.

CO4: Students defining the need for modulation involves understanding the practical requirements of communication systems. This understanding is essential for designing modulation schemes that meet specific communication goals and constraints.

CO5: Students explaining the behavior of communication systems in the presence of noise is crucial for designing solutions that enhance signal integrity and minimize the impact of noise on communication. This knowledge contributes to effective system design.

CO6: Students able to comparing modulation schemes involves evaluating their suitability for different communication scenarios. This knowledge is valuable for designing solutions that employ the most effective modulation scheme based on specific requirements.

CO7: Calculating the bit error rate for digital modulation schemes is essential for assessing their performance. This skill is valuable for designing solutions that meet specific error rate criteria in digital communication systems.

PO3: Modern tool usage:

CO1: Students will develop understanding about fundamental concepts may involve the use of modern tools for simulation, modeling or analysis in communication systems.

CO3: Students having ability to compare and contrast communication systems which involves the use of modern tools to gather, analyze and present data. Students may use data analysis tools, simulation software or other modern tools to enhance their ability to evaluate communication systems.

CO4: Defining the need for modulation may involve the use of modern tools for signal analysis and visualization. Students can use software tools to explore and demonstrate the benefits of modulation in communication systems.

CO6: Comparing modulation schemes can be facilitated through the use of simulation and analysis tools. Students can utilize modern tools to simulate and compare the performance of various analog and digital modulation schemes.

PO6: Individual and teamwork:

CO1: Student having understandings about fundamental concepts may involve individual study and research. However, teamwork might be required for collaborative projects or discussions where different perspectives contribute to a more comprehensive understanding.

CO2: For getting some concepts student may require individual understanding, but teamwork can be valuable for discussing complex scenarios or solving problems collaboratively, bringing diverse insights to the analysis of signal and noise in communication systems.

CO3: Developing the ability to compare and contrast communication systems is a skill that can be honed individually, but collaborative efforts may provide a broader range of perspectives and foster a more thorough analysis of strengths and weaknesses.

CO4: Defining the need for modulation involves individual understanding of the theoretical aspects. However, teamwork may be beneficial for brainstorming and collectively exploring real-world applications and scenarios where modulation is essential.

CO6: Students able to compare modulation schemes involves individual analysis, but teamwork is valuable for sharing insights, discussing trade-offs and collectively evaluating the pros and cons of different modulation techniques.

CO7: Calculating bit error rate for digital modulation schemes may require individual mathematical proficiency, but teamwork can be beneficial for cross-verification, sharing methodologies, and collectively addressing challenges in the calculation process.

PO7: Innovation, Employability and Entrepreneurial skills:

CO1: Students are able to understand fundamental concepts which is the base for innovation in communication systems. This knowledge enhances employability by providing a solid foundation for individuals to contribute to innovative solutions and entrepreneurial endeavors in the field.

CO2: Students ability to explain and analyze signal-to-noise ratio and noise characteristics is crucial for innovation in communication systems. Understanding these parameters enhances employability by making individuals valuable contributors to innovative solutions and entrepreneurial ventures.

CO4: Students having ability to defining the need for modulation involves understanding practical applications. This knowledge enhances employability by preparing individuals to contribute innovative ideas for modulation techniques and entrepreneurial solutions in communication systems.

CO5: Students able to explain the behavior of communication systems in the presence of noise is crucial for innovation. Individuals who understand and can address noise-related challenges are better positioned for employability.

CO6: Comparing modulation schemes requires understanding their advantages and disadvantages. This knowledge contributes to innovation, employability, and entrepreneurship by enabling individuals to propose novel solutions and make informed choices in communication system design.

CO7: Calculating the bit error rate is essential for assessing the performance of digital modulation schemes. Individuals with these skills are valuable contributors to innovative projects and entrepreneurial initiatives in the communication technology sector.

ELE 3602: Paper II: Embedded Systems and Programming

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 Systems **[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: Interfacing with 8051 using Embedded C Programming **[8]**

Interfacing of Devices with 8051 microcontroller using 8051 C: LED, SSD, LCD, Stepper Motor, DAC, and ADC.

Unit 3: Embedded Systems using Single Board Computers (SBC) **[16]**

SBC Block diagram, Types, Comparison of SBC models, Specifications, I/O devices (Storage, Display, Keyboard, Mouse), Network Access Devices. Introduction to Arduino: Microcontrollers used in Arduino, Pin configuration and architecture, Concept of digital and analog ports. Arduino programming: 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, Division

Recommended Books-

The 8051 Microcontroller Architecture, Programming, and application [Second Edition] Kenneth J. Ayala, Penram International (1999)
The 8051 Microcontroller and Embedded Systems using Assembly and C M.A. Mazidi, J. G. Mazidi, R.D. Mckinlay. Pearson Education Second Edition 2009
Learning Python with Raspberry Pi, by Alex Bradbury, Ben Everard, John Wiley & Sons, Inc
Think Python, Allen Downey,
O'Reilly, 2012 2. Introduction to Problem Solving with Python, E. Balagurusamy
Arduino-Based Embedded Systems: By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury.

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

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.

CO2: Acquiring basic knowledge about programming and system control is essential for critical thinking and problem-solving in the design and implementation of embedded systems.

CO3: Acquiring knowledge about devices and buses used in embedded networking is crucial for problem-solving in the field of embedded systems.

CO4: Developing programming skills in embedded systems enhances critical thinking and problem-solving abilities when addressing various applications in the discipline.

CO6: Being familiar with the Arduino microcontroller board directly aligns with critical thinking and problem-solving skills in the context of embedded systems.

CO7: Learning Arduino IDE and Python programming enhances critical thinking and problem-solving abilities in the practical implementation of embedded systems.

PO3: Social competence

CO2: Acquiring basic knowledge about programming and system control contributes moderately to social competence as it establishes a technical skill set but may not directly address interpersonal or communication skills.

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

CO2: Acquiring a basic knowledge about programming and system control is moderately related to research-related skills, as it contributes to technical skills but may not directly involve independent experimentation or hypothesis establishment.

CO4: Developing programming skills in embedded systems is moderately related to research-related skills, as it contributes technical skills but may not directly involve laboratory techniques or independent experimentation.

CO5: 1 (Partially related) - Knowledge of various Single Board Computers (SBCs) and their comparison is partially related to research-related skills, as it extends beyond the core focus on microcontrollers and may not directly contribute to laboratory techniques or independent experiments.

CO6: 1 (Partially related) - Being familiar with the Arduino microcontroller board is partially related to research-related skills, as it provides technical knowledge but may not directly involve independent experimentation or laboratory techniques.

CO7: 2 (Moderately related) - 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

CO1: Acquiring basic knowledge about fundamentals of microcontrollers contributes to personal competence, but the direct emphasis on collaboration or interdisciplinary fields is not explicit.

CO2: Acquiring basic knowledge about programming and system control involves personal competence, but the direct emphasis on collaboration or interdisciplinary fields is not explicit.

CO4: Developing programming skills in embedded systems for various applications requires both personal competence and the potential for collaborative work across interdisciplinary fields.

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.

CO6: Being familiar with the Arduino microcontroller board is technical and may not explicitly involve considerations of empathetic social concern, equity, or ethical awareness.

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

CO2: Acquiring a basic knowledge about programming and system control provides essential skills for self-directed and life-long learning, especially in the evolving landscape of socio-technological changes.

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.

ELE3603: Paper III: Power Devices And Circuits

SEMESTER: VI　　CREDITS : 3　　LECTURES : 48

Course 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.

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.

Note: **Scope of the syllabus is limited to single phase circuit**

Unit 1: Introduction to Power Electronics [6]

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, Protection and Driving circuits [14]

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, UJT and PUT.

Unit 3: Power Circuits [18]

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, Voltage control methods, Inverter filters, introduction to current source inverter

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Switches : DC Switches, Solid state relays, AC Switches and Microelectronic relays

Unit 4: Applications [10]

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)

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

PO1: Disciplinary Knowledge

CO1: Disciplinary Knowledge is built by acquiring the basics of power electronics, forming the foundational understanding necessary for specialization in the field.

CO2: Disciplinary Knowledge is expanded by knowing various power devices, providing a specialized understanding crucial for effective analysis and design in power electronics.

CO3: Disciplinary Knowledge is strengthened by understanding power circuits, enabling a comprehensive grasp of the fundamental building blocks in power electronics systems.

CO4: Disciplinary Knowledge is advanced by analyzing rectifiers, regulators, and inverters, fostering a deep understanding of the key components and their functions in power electronic systems.

CO5: Disciplinary Knowledge is broadened by learning about switches and controlled rectifiers, providing insights into crucial components and mechanisms within power electronics.

CO6: Disciplinary Knowledge is refined by analyzing waveforms in power circuits, allowing for a detailed understanding of signal behavior and enhancing proficiency in power electronics analysis.

CO7: Disciplinary Knowledge is completed by understanding power supplies and motor drives, ensuring a comprehensive knowledge base for designing and implementing complete power electronic systems.

PO2: Critical Thinking and Problem solving

CO1: Applying analytical reasoning to grasp the foundational concepts, enabling effective problem-solving in power electronics.

CO2: Understanding various power devices, allowing for informed decision-making in selecting and utilizing appropriate components in power electronic systems.
CO3:Cultivated through the comprehension of power circuits, fostering the ability to analyze and troubleshoot complex issues in the design and operation of power systems.
CO4: Analyzing rectifiers, regulators, and inverters, enabling the identification and resolution of challenges in the performance of power electronic devices.
CO5: Learning about switches and controlled rectifiers, providing the knowledge needed to address challenges in the selection and implementation of these components.
CO6: Analyzing waveforms in power circuits, allowing for a systematic approach to problem-solving related to signal behavior and performance optimization.
CO7: Understanding power supplies and motor drives, facilitating the resolution of complex issues related to the design and operation of complete power electronic systems.

PO3: Social competence

CO1: Acquiring foundational knowledge, enabling effective communication and collaboration with peers, educators, and professionals in the field of power electronics.
CO2: Knowing various power devices, facilitating meaningful interactions and discussions with colleagues and stakeholders involved in the design and application of power electronic components.
CO3: Understanding power circuits, promoting collaborative efforts in multidisciplinary projects where power electronics knowledge is essential for effective teamwork.
CO4: Analyzing rectifiers, regulators, and inverters, as it enables effective communication with team members and stakeholders regarding the design and performance of power electronic systems.
CO5: Learning about switches and controlled rectifiers, facilitating collaborative decision-making and knowledge-sharing in projects involving power electronic components.
CO6: Analyzing waveforms in power circuits, fostering effective communication of complex technical information and facilitating collaboration in projects involving power electronics.
CO7: Understanding power supplies and motor drives, promoting effective teamwork and communication in the design and implementation of complete power electronic systems.

PO4: Research-related skills and Scientific temper

CO1: delving into the basics of power electronics, fostering a curious and analytical mindset essential for exploring and understanding foundational concepts.
CO2: understanding various power devices, cultivating the ability to critically assess and stay updated on advancements in power electronics components through research.
CO3: developed by comprehending power circuits, encouraging systematic investigation and analysis of circuit behaviors in alignment with scientific principles.
CO4: refined through the analysis of rectifiers, regulators, and inverters, promoting a methodical approach to experimentation and exploration in power electronics research.
CO5: enriched by learning about switches and controlled rectifiers, fostering the ability to evaluate and contribute to advancements in power electronics through informed and research-oriented decision-making.
CO6: analyzing waveforms in power circuits, promoting a systematic investigation of signal behaviors and encouraging a scientific approach to optimizing power system performance.
CO7: understanding power supplies and motor drives, enabling a research-oriented mindset to explore innovative solutions and advancements in the design and implementation of power electronic systems.

PO5: Trans-disciplinary knowledge

CO1: acquiring the basics of power electronics, providing a foundation that facilitates integration with diverse disciplines where power electronic concepts are applicable.

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CO2: knowing various power devices, bridging the gap between electronics and engineering disciplines and enabling a broader understanding of their applications in various technological domains.
CO3: understanding power circuits, allowing for the application of power electronics concepts in multidisciplinary projects where knowledge of power systems is essential.
CO4: cultivated through the analysis of rectifiers, regulators, and inverters, providing insights that can be applied in diverse applications beyond power electronics, such as energy systems and control engineering.
CO5: learning about switches and controlled rectifiers, facilitating a broader perspective on the integration of power electronic components into diverse technological applications.
CO6: analyzing waveforms in power circuits, allowing for the application of signal analysis skills in various domains beyond power electronics, such as telecommunications and signal processing.
CO7: understanding power supplies and motor drives, fostering a holistic understanding that can be leveraged in various engineering disciplines, including automation and robotics.

PO6: Personal and professional competence

CO1: cultivated by acquiring the basics of power electronics, laying the foundation for a well-rounded understanding essential for effective contributions in the professional arena.
CO2: enhanced by knowing various power devices, fostering the expertise necessary for informed decision-making and proficient engagement in power electronics-related projects.
CO3: developed by understanding power circuits, providing the knowledge and skills required to contribute effectively to the design and optimization of power systems in a professional context.
CO4: refined through the analysis of rectifiers, regulators, and inverters, enhancing the ability to apply critical thinking and problem-solving skills to real-world power electronics challenges.
CO5: is enriched by learning about switches and controlled rectifiers, enabling versatility and adaptability in applying power electronics knowledge to various professional contexts.
CO6: advanced by analyzing waveforms in power circuits, demonstrating proficiency in signal analysis and contributing to the improvement of power system performance in a professional setting.
CO7: applied in understanding power supplies and motor drives, facilitating effective engagement in projects involving the design and implementation of complete power electronic systems.

PO9: Self-directed and Life-long learning

CO1: encouraged by instilling the curiosity and motivation needed to independently seek additional knowledge and advancements in power electronics beyond the basics.
CO2: fostered by inspiring the desire to stay updated on emerging power devices and technologies, promoting continuous education and adaptability throughout one's career.
CO3: cultivated by emphasizing the importance of ongoing education and exploration to deepen the understanding of power circuits and adapt to evolving technologies in the field.
CO4: advanced by encouraging the continuous analysis and exploration of rectifiers, regulators, and inverters, fostering a commitment to staying informed and improving problem-solving skills.
CO5: enriched by promoting ongoing learning about switches and controlled rectifiers, motivating individuals to seek knowledge independently and adapt to evolving industry trends.
CO6: refined by emphasizing the importance of continuously analyzing waveforms in power circuits, promoting a commitment to ongoing education and skill enhancement.
CO7: applied by fostering the mindset of continuous education and exploration, encouraging individuals to stay updated on power supplies and motor drives throughout their professional journey.

ELE 3604: Paper IV: Foundation of Nanoelectronics

SEMESTER: VI CREDITS : 3 LECTURES : 48

Course Objectives:

1. To learn Maxwell Equation.
2. To understand concept of Electromagnetics.
3. To know the principles of quantum mechanical aspects
4. To learn Uncertainty principle
5. To learn statistical aspect.
6. To understand concept of electron transport
7. To study the basics of nano electronics.
8. To Understand Application of nano electronics

Course Outcomes:-

CO1: Student will understand Maxwell Equation
CO2:Concept of Electromagnetics.
CO3:Concept of quantum mechanical aspects.
CO4: Basic of uncertainty Principle.
CO5: Concept of electron transport
CO6: Basics of Nano electronics.
CO7:Application of Nano electronics.

Unit 1: Essential Electromagnetics [12]

Lorentz force-Motion of charged particle in E-M fields, cyclotron frequency, Hall effect, Maxwell's equations, Relation with laws of Electrodynamics, 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, Qualitative treatment of square wave potential with special reference to tunnelling phenomenon.

Unit 3: 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: Nanoelectronics [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, electrons in quantum dots, 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

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	3	3	1	2	1	2	3	1
CO2	2	1	2	1	3	-	3	-	-
CO3	-	3	-	2	-	3	-	-	-
CO4	-	-	-	2	2	-	2	1	1
CO5	2	1	2	3	-	-	-	-	-
CO6	-	-	-	1	2	-	-	-	-
CO7	2	1	-	-	-	-	-	-	-

Justification For The Mapping

PO1 (Disciplinary Knowledge)
CO1: Understanding Maxwell's equations is fundamental to the discipline of electromagnetics.
CO2: Understanding the concept of electromagnetics is a core element of the discipline.
CO5: Understanding electron transport is fundamental in the study of electronic devices.
CO7: Applying nano electronics requires a deep understanding of the discipline.

PO2: Critical Thinking and Problem solving:
CO1: Comprehending and working with Maxwell's equations involves critical thinking.
CO2: Grasping the concept involves critical thinking and problem-solving skills.
CO3: Grasping quantum mechanical concepts involves critical thinking.
CO5: Analyzing electron transport involves critical thinking.
CO7: Applying nano electronics involves critical thinking and problem-solving skills.

PO3: Social competence
CO1: Understanding these equations is part of social competence in electromagnetics.
CO2: Studying electromagnetics involves social competence.
CO3: solid understanding of electron transport enhances social competence.

PO4: Research-related skills and Scientific temper
CO1 to CO6: All co matched with research related skill and scientific temper.

PO5: Trans-disciplinary knowledge
CO1: Comprehending and working with Maxwell's equations involves Trans-disciplinary knowledge.
CO2: Studying electromagnetics involves Trans-disciplinary knowledge
CO4: Understanding the basics of the Uncertainty Principle is Trans-disciplinary knowledge.
CO6: Understanding the basics of nano electronics is Understanding the basics of nano electronics is fundamental in the field of nanotechnology.

PO6: **Personal and professional competence**
CO1: Mastery of Maxwell's equations enhances professional competence in electromagnetics.

CO3: A solid understanding of quantum mechanics enhances professional competence.

PO7: Effective Citizenship and Ethics

CO1: Comprehending and working with Maxwell's equations involves Effective Citizenship and Ethics

CO2: Grasping the concept involves Effective Citizenship and Ethics

CO4: Grasping the Uncertainty Principle involves Effective Citizenship and Ethics

PO8:Environment and Sustainability

CO1: Understanding Maxwell's equations is fundamental to the Environment and Sustainability of electromagnetics.

CO4: Understanding this principle is part of Environment and Sustainability in quantum mechanics.

PO9: Self-directed and Life-long learning

CO1: Understanding Maxwell's equations is fundamental to the Self-directed and Life-long learning of electromagnetics.

CO4: Understanding this principle is part of Self-directed and Life-long learning in quantum mechanics.

ELE3605: Paper V: Mathematical Methods and Circuit Simulation 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

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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, 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

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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.

ELE 3606: 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　[14]

Functional Elements of an instrument, Active and passive transducers, Analog and Digital Modes of Operation, Null and Deflection Methods, Input Output configuration of Instruments and measuring systems. Working principle and specification of thermal sensors like thermistor, thermocouple, optical sensors photodetector, and optical encoder, Mechanical sensor LVDT, magnetic sensor hall effect. Study of electromechanical relay, LED, /LCD display.

Unit 2 : Manipulating, Computing and Compensating devices　[10]

Operational Amplifiers, 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, Multiplexers and Sample - Hold circuits.

Unit 3: Fundamentals of Process automation　[12]

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 4: Controller modes　[12]

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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.

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ELE3607: Paper VII: Practical Course- I

SEMESTER: VI **CREDITS: 2**

There are 10 Experiments in Paper VII ELE3607 : Practical Course- I

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

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 refer the various datasheets of the electronic devices and integrated circuits
2. To learn how to select the devices, sensors, actuators and ICs for a particular application
3. To develop the basic skills required to handle the various instruments
4. To learn the designing aspects of circuits/ systems
5. To learn basic of communication system.
6. To study power electronics circuit.
7. To understand concept of OFC

Course Outcome:

CO1: Basic of Datasheets
CO2: Concept of sensor
CO3: handling various instrument.
CO4: Designing circuit.
CO5:Concept of communication system.
CO6:-Basics of power electronics Circuit.
CO7: Working of OFC.

LABORATORY EXPERIMENTS (Total 8 experiments)

Group A : Industrial Automation (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 : Communication Systems (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.

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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.

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	3	3	3	2	1	2	1	1
CO2	2	1	1	1	3	-	1	-	-
CO3	-	3	-	2	-	1	-	-	-
CO4	-	-	-	2	-	-	2	-	-
CO5	1	1	-	3	-	-	-	-	-
CO6	-	-	-	1	2	-	-	-	-
CO7	2	1	-	-	-	-	-	-	-

Justification For The Mapping

PO1:Disciplinary Knowledge

CO1: Understanding datasheets is fundamental to gaining knowledge in electronic devices and components.

CO2: Understanding the concept of sensors is essential for the study of various electronic systems.

CO5: Understanding communication systems is fundamental to the field of electronics.

CO7: Understanding OFC involves Disciplinary Knowledge

PO2: Critical Thinking and Problem solving:
CO1: Interpreting and using datasheets require critical thinking skills
CO2:Applying sensor concepts to real-world scenarios involves critical thinking
CO3: Learning to handle various instruments involves problem-solving skills.
CO5: Analyzing and designing communication systems involve critical thinking.
CO7: Analyzing and designing OFC systems involve critical thinking
PO3: Social competence
CO1: Referencing and understanding datasheets is part of the research process in electronics.
CO2: Understanding sensor technology enables effective communication in Social competence
PO4: Research-related skills and Scientific temper
CO1 to CO6: All co matched with research related skill and scientific temper.
PO5: Trans-disciplinary knowledge:
CO1: Understanding datasheets is Trans-disciplinary knowledge to gaining knowledge in electronic devices and components.
CO2: Understanding the concept of sensors is essential for the study of various electronic systems.
CO6: Understanding the basics of power electronics circuits is Trans-disciplinary knowledge
PO6: Personal and professional competence
CO1: Proficiency in using datasheets enhances professional competence.
CO3: Proficiency in handling instruments enhances professional competence.
PO7: Effective Citizenship and Ethics
CO1: Understanding datasheets is Effective Citizenship and Ethics to gaining knowledge in electronic devices and components.
CO2: Understanding the concept of sensors is essential for the study of various electronic systems.
CO4: Designing circuits requires Effective Citizenship and Ethics
PO8: Environment and Sustainability:
CO1: Interpreting and using datasheets require Environment and Sustainability
PO9: Self-directed and Life-long learning:
CO1: The ability to understand and use datasheets is a skill that supports continuous learning in the ever-evolving field of electronics.

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ELE3608: Paper VII: Practical Course- II

SEMESTER: VI **CREDITS: 2**

There are 10 Experiments in Paper VII ELE3608 : 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

Semister Practical Examination (Out of 60)

· One experiment - 3 hours duration (60 Marks)

· 44 Marks to Experiment, 16 marks toactivity

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.

LABORATORY EXPERIMENTS (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. Do it Yourself Open ended Project.

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 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.

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ELE3609: Paper IX: Practical Course- III
Project Work

SEMESTER: VI **CREDITS: 2**

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: 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) The name and subject of the project type must be well defined.
b) Planning of the work must be specified.
c) Theoretical, reference work must be provided.
d) Pilot experimentations / Preparations must be specified.
e) Typical design aspects, theoretical aspects, aim and objectives of the work must be specified in detail.
f) The actual work done must be reported along with experimentation procedures.
g) There must be observations, interpretations, conclusions, results of the project work.
h) Algorithm, program strategy, module wise description of parts etc be provided in case of projects related with development of computer software.
i) Applications, usefulness, student's contribution in it must be clearly specified.
j) Further extension work may be suggested for better outcome of the project.
k) It is recommended to present the projects in competitions / project exhibitions organized by various authorities.

Note:
- **No of students for practical per batch = 12**
- **No of students for project per batch = 05**
- **Study Tour / Industrial visit equivalent to four practicals.**

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	-	-	3	-	-	-	-	-
CO2	-	-	-	2	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-
CO4	-	-	-	1	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-
CO7	-	-	-	-	-	-	-	-	-

Justification For The Mapping

PO1: Disciplinary Knowledge

CO1: Creating and designing a project inherently involves applying disciplinary knowledge in order to develop a well-informed and effective solution.

PO2: Critical Thinking and Problem Solving

CO3: "Present and defend the project relevance/creation/design/implementation/simulation." This involves critical thinking and problem-solving skills during the presentation and defense.

PO4: Research Related Skills and Scientific Temper

CO1: "Create/Design the project" and CO4: "Prepare project report in a standard format." Both involve applying research-related skills and adopting a scientific temper.

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