Anekant Education Society's

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

Academic Year 2020-2021(2019 Pattern)

Course Structure For M.Sc.- II : Electronic Science

Semester	Paper Code	Title of Paper	No. of Credits
III	ELE4301	Advanced Communication Electronics	4
	ELE4302	Advanced Embedded Systems	4
	ELE4303	Digital Signal Processing	4
	ELE4304	Programmable Logic Controllers and Applications	4
	ELE4305	Practical Course –V	4
	ELE4306	Practical Course –VI	4

ELE4301: Advanced Communication Electronics (4 Credits) Semester-III

Objectives:

1. Study the noise and source.
2. To learn analog modulation techniques
3. To study basics of information theory and digital communication
4. To learn various digital coding techniques.
5. To study various data digital communication systems
6. To make students aware of various communication technologies.
7. To learn advanced communication system.

Course Outcome:
CO1. Learn the power distribution in AM.
CO2. Student will be able to learn digital modulation techniques.
CO3. Student will be able to learn Analog modulation techniques
CO4. Develop ability to Detection and Error Correction.
CO5. To know the working principle of advanced digital communication systems
CO6. Student will be able to explain the frequency spectrum band.
CO7. Student will be able to learn advanced communication technology.

Unit 1: Analog communication

Communication systems, Modulation, Bandwidth requirements, External and Internal noise, Theory of Amplitude modulation, Power distribution, Generation of AM, Suppression of carrier, suppression of unwanted side Bands, Extensions of SSB. Theory of frequency and Phase modulation, sidebands and modulation index, Noise and Frequency modulation, Generation of FM, FM receivers. Analog base band Transmission,

Unit 2: Digital Communication

Pulse modulation, Pulse amplitude modulation, pulse width modulation, pulse position modulation, Delta modulation, Adaptive delta modulation, Digital modulation techniques- ASK, FSK, PSK, QAM, M-ary digital modulation techniques. Digital base band transmission. Coding Techniques- Introduction to the Coding, Alpha - Numeric coding, Parity Check Coding, Hamming Code, Concept of Systematic Code, RZ, NRZ, Manchester code, AMI, Error Detection and Error Correction.

Unit 3: Advanced Digital Communication Systems

Satellite Communication, Telephone, Cellular Phones, Dual Tone Multi Frequency (DTMF) dialing, Integrated Services Digital Network (ISDN)., spread spectrum techniques, OFDM, 3G wireless, IP telephony, Bluetooth, IrDA, CDMA

Unit 4: Communication Technologies

Local Loop, PSTN, ISDN, digital exchanges, Principles of Telemetry, satellite communication and VSAT, GSM,

Text / Reference Books

1. Electronic Communication Systems, George Kennedy and Bernard Davis Publ. Tata McGraw Hill.
2. Electronic communications, Dennis Roddy and John Coolen, Pearson Publ.
3. Communication Electronics Principles and applications, Louis E. Frenzel, Tata McGraw Hill.
4. Digital data communication, Miller

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

Justification for the mapping

PO1: Disciplinary Knowledge

The course outcomes (COs) contribute to the development of students' disciplinary knowledge in communication engineering. For example, CO1, CO2, CO3, CO5 and CO6 require students to analog and digital modulation fundamental concept in communication engineering. CO4 and CO7 require students to apply these concepts to error detection in communicated signal and learn advance communication technology.

PO2: Critical Thinking and Problem Solving

All of the COs contributes to the development of students' critical thinking and problem-solving skills. For example, CO1, CO2, CO3, CO5 and CO6 require students to think critically about analog and digital communication techniques, spectrum band requirement. CO4 required for detection and error correction involve critical thinking to identify and solve problems in communication systems. how to apply different transformation method to solve problems. CO7 require students to use their knowledge for advanced communication technology.

PO3: Social competence

CO4, CO5 and CO6: It is required for explaining the frequency spectrum band involves effective communication, contributing to social competence in conveying technical information to diverse audiences.

.**PO4: Research-related skills and Scientific temper**

The entire COs contributes to the development of students' research-related skills and scientific temper. CO2, CO3 and CO7 require students to Understanding power distribution in AM involves a scientific approach and research skills in exploring the principles of analog and digital modulation as well as advance communication technology.

PO5: Trans-disciplinary knowledge

All the COs contribute to the development of students' trans-disciplinary knowledge. CO2, CO3 and CO4 require students to understanding advanced digital and analog communication systems requires knowledge that spans multiple disciplines within the broader field of communication engineering.

PO6: Personal and professional competence

CO32, CO3, CO5, CO7 all contribute to the development of students' personal and professional competence. For example, learning advanced communication technology enhances personal and professional competence in keeping up with technological advancements in the field.

PO7: Effective Citizenship and Ethics

CO2, CO3, CO7: required for understanding the ethical considerations in communication technology aligns

PO8: Environment and Sustainability

CO2, CO3, CO7: required for understanding the environmental impact of communication systems is crucial for promoting sustainability in the field.

PO9: Self-directed and Life-long learning

CO2, CO3, CO4, CO6 and CO7 all contribute to the development of students' ability to engage in self-directed and life-long learning. For example, the entire COs is essential for staying updated in the rapidly evolving field of communication engineering.

ELE4302: Advanced Embedded Systems (4 Credits)

Course Objectives:

1. To study the architecture of Advanced RISC machine (ARM7)
2. To learn assembly level programming of ARM-7 and interfacing hardware
3. To get acquainted to fundamentals of operating system
4. To get familiar with real time operating system (RTOS)
5. To introduce Raspberry pi.
6. To understand Programming
7. To understand concept of embedded system.

Course Outcomes:

CO1. Design embedded applications with operating system support.
CO2. Instruction set of ARM
CO3. Concept of Interfacing.
CO4. Basic programming of RTOS
CO5. Interfacing of ARM to Various Sensor
CO6. Concept of Raspberry pi.
CO7. Programming of raspberry pi to real world.

Unit-1:

Advanced Risc Machine (ARM-7) ARM7 CPU Core,Processor Architecture (32-bit), ARM Programmer's Model, ARM Development Tools, Introduction to ARM families, ARM7TDMI Features,Pipelining, Exepections, Interrupt Vector Table, ARM Instruction Set, Thumb Instruction System Peripherals: Bus Structure, Memory Map, Register Programming, PLL User Peripherals: GPIO, PWM Modulator, RTC, Watchdog Timer, UART, I2C, SPI, ADC, DAC, CAN Overview of ARM Cortex M1, Cortex M2, Cortex M3

Unit-2 :

Introduction to Operating Systems Brief history of OS, Operating system basics and types of operating systems The BIOS and Boot Process: BIOS Actions, Operating System, Boot Process System calls, files, processes, design and implementation of processes, communication between processes Memory Management: segmentation and paging Memories: virtual, cache etc.

Unit-3:

Real Time Operating Systems (RTOS) Operating System basics, Types of Operating Systems, Tasks, Process, Threads, Multiprocessing and Multi tasking, Task Scheduling, Threads-Processes-Scheduling putting them together, Task Communication, Task Synchronization, Device Drivers, How to choose an RTOS

Unit-4:

Raspberry Pi with Python Basic functionality of the Raspberry Pi board and its processor, setting and configuring the board, differentiating Raspberry pi from other platform like arduino, asus thinker etc., overlocking Component overview.Communication facilities on Raspberry pi(I2C,SPI,UART)working with RPil. GPIO library, interfacing of Sensors and Actuators.

Text / Reference Books:

1. "ARM System On Chip Architecture", By Steve Furber, Pearson
2. ARM System Developer"s Guide Designing and Optimizing Systems Software, by Andrew Sloss, Elsevier
3. The insider"s guide to the PHILIPLS ARM7 based Microcontrollers, An Engineer Introduction LPC2100 Series, Trevor Martin, Hitex ltd
4. LPC 214x User Manual
5. Operating System Concepts and Techniques,M. Naghibzadeh.
6. Operating Systems Concept, Galvin, John Willey and Sons
7. Raspberry Pi for Python Programmers Cookbook - Second Edition 2nd Edition, Kindle Edition
8. Raspberry Pi® User Guide, 4Eben Upton Gareth Halfacre

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: This CO aligns with the need for disciplinary knowledge as it involves understanding the integration of hardware and software for embedded applications.

CO2: Understanding the ARM instruction set is crucial disciplinary knowledge in computer engineering, particularly in embedded systems.

CO3: The concept of interfacing is a foundational aspect of disciplinary knowledge, involving the integration of different components in embedded systems.

CO5: Integrating ARM with sensors involves applying disciplinary knowledge to practical sensor applications.

CO7: Programming Raspberry Pi for real-world applications aligns with the need for disciplinary knowledge, translating theoretical understanding into practical solutions.

PO2: Critical Thinking and Problem Solving

CO1 to CO7(Except CO4):- All course outcomes involve critical thinking and problem-solving skills. Designing embedded applications, understanding instruction sets, interfacing, and programming various platforms all require analytical thinking and problem-solving abilities**.**

PO3: Social Competence

CO1: Understanding sensor interfacing has social implications, especially in hardware and software that impact daily life.

CO2: Considering ethical implications in real-world applications aligns with effective citizenship and ethics, ensuring responsible use ARM instruction set.

CO5: Integrating ARM with sensors involves applying social knowledge to practical sensor applications.

PO4: Research-related Skills and Scientific Temper

CO1 to CO6**:-** All course outcomes involve Research related skills and scientific temper. Designing embedded applications, understanding instruction sets, interfacing, and programming various platforms all require.

P05: Trans-disciplinary Knowledge

CO1 to CO6 (Except CO3):- versatility encourages trans-disciplinary knowledge, as it finds applications in various domains.

PO6: Personal and Professional Competence

CO1: sensor interfacing has important in professional development, especially in hardware and software that impact daily life.

CO2: Considering professional development ensuring responsible use ARM instruction set.

CO3: Mastering interfacing is a key competence in the professional development of engineers.

PO7: Effective Citizenship and Ethics

CO1: sensor interfacing has important in effective citizenship and ethics especially in hardware and software that impact daily life.

CO2: Considering ethics responsible use ARM instruction set.

CO4: Developing skills in RTOS programming involves a scientific approach and effective citizenship important

CO6:for effective citizenship raspberry pi important

PO8: Environment and Sustainability

CO1: sensor interfacing has important in environment and sustainability.

CO2: Considering sustainability use of ARM instruction set.

CO4: Developing skills in RTOS programming involves sustainability

PO9: Self-directed and Life-long learning:

CO1: Interfacing of ARM to Various Sensor is Self-directed and Life-long learning

CO2:Instruction set of ARM is life long learning.

CO5:Design embedded applications with operating system support is self directed learning.

ELE4303: Digital Signal Processing (4 Credits)

Objectives:

1. To get acquainted to fundamental aspects of Digital Signal Processing (DSP).
2. To become aware of mathematical background required for DSP.
3. To learn design of digital filters and implementation on digital Signal Processor
4. To study DSP applications.
5. To make the students able to apply digital filters according to known filter specifications.
6. To provide the knowledge about the principles behind the discrete Fourier transform (DFT) and its fast computation.
7. To be able to apply the MATLAB programm to digital processing problems and presentations.

Course Outcomes:

On completion of the course, students will be able to –

- CO1. Interpret and process discrete/ digital signals, systems and represent DSP system.
- CO2. Implement efficient transform/ algorithm and its application to analyze DT signals.
- CO3. Analyze DFT transform for DT signals.
- CO4. Solve the problems on DFT and IDFT.
- CO5. Know FFT algorithms of DT signals.
- CO6. Design and implement IIR filters and FIR filters.
- CO7. Apply knowledge of DSP prosessor in various applications.

Unit-1: Signals and Systems

Overview: Classification of Signals and Systems: continuous time and discrete time, signal types, amplitude and phase spectrum, classification of systems. Real time DSP system and interfacing A-D conversion process, sampling, quantization and encoding, oversampling and antialiasing, Nyquist rate & aliasing problem, anti aliasing, Pulse Sampling, one bit ADC, DAC conversion process, oversampling

Unit-2: Mathematical Tools for DSP

Introduction to Fourier series, Fourier series Representation of periodic signals, Dirichlet Conditions, Evaluation of Fourier coefficients, Properties of Fourier Transform (FT), Discrete Fourier Transform (DFT) and its inverse DFT, Existence of DFT, properties of DFT, Circular convolution, sampling of continuous signal, Fast Fourier Transform (FFT) DIT, DIF algorithm and their comparison and its computational advantage. Inverse FFT, implementation of FFT, DIT and DIF algorithm

Unit-3: Digital Filter Design

Frame work of digital filter design: introduction, types – infinite impulse response (IIR), finite impulse response (FIR)

FIR filter: features, filter design steps, design, filter specifications, coefficient calculation methods, window method, optimal method, frequency sampling method, FIR filter design using

Kaiser window, realization structure for FIR filter, finite word length effects, and implementation of FIR filters
IIR Filter: basic features, design steps, coefficient calculation, poles-zeros placement, impulse invariant method, bilinear transform, Matched z-transform, Nyquist effect, realization structure for IIR filter, finite word length effects, implementation of IIR filters

Unit-4: DSP Processor and Application Areas
Introduction to DSP processors, types of DSP processors and architecture, general purpose DSP processors; implementation of noise removal techniques, echo, chorus and flange effects introduced in music, implementation of DSP algorithm for FIR, IIR filtering

Text /Reference Books:

1. Digital Signal Processing: A Practical Approach, Emmanuel Ifeachor, Barrie Jervis, Prentice Hall.
2. Digital Signal Processing: S. Salivahan, A. Valuraj, C.Gnanapriya, Tata McGraw Hill, Pub. Co. Ltd. Edn. 2006.
3. Digital Signal Processing: A Hands on Approach: Charles Schuller, Mahesh Chugani, Tata McGraw Hill Pub. Co. Ltd. Edn. 2006.
4. Digital Signal Processing: - Principles, Algorithms and Applications: John G Proakis, Dimitris G Monolkis, and Pub. Person 2005.Operating Systems Concept, Galvin, John Willey and Sons.
5. Digital Signal Processing and Applications with the C6713 and C6416 DSK,

1. Rulph Chassaing, a John Wiley & Sons, Inc.

6. The Scientist and Engineer's Guide toDigital Signal Processing, Steven W. Smith Second Edition California Technical Publishing.

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

Justification for the mapping

PO1 :Disciplinary Knowledge:

CO1: Understanding and interpreting discrete signals and systems is fundamental to disciplinary knowledge in Digital Signal Processing (DSP).
CO2: Implementing efficient transforms and algorithms for analyzing discrete-time signals is a crucial aspect of disciplinary knowledge in DSP.

CO3,CO4: Analyzing and solving problems related to the Discrete Fourier Transform (DFT) contribute to a deep understanding of DSP, aligning with disciplinary knowledge.
CO5: Knowing Fast Fourier Transform (FFT) algorithms for discrete-time signals is an integral part of disciplinary knowledge in DSP.
CO6: Designing and implementing Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) filters is a direct application of disciplinary knowledge in DSP.
CO7: Applying DSP processor knowledge to various applications demonstrates the practical application of disciplinary knowledge in real-world scenarios.

PO2 Critical Thinking and Problem solving

CO1: Critical thinking is applied in interpreting and processing digital signals, solving problems related to signal representation, and understanding DSP systems.
CO2: Critical thinking is employed in implementing efficient transforms and algorithms for the analysis of discrete-time signals.
CO3,CO4: Analyzing and solving problems related to the Discrete Fourier Transform (DFT) requires critical thinking skills.
CO5: Understanding and applying Fast Fourier Transform (FFT) algorithms involve critical thinking in dealing with complex signal processing tasks.
CO6: The design and implementation of Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) filters require critical thinking in solving engineering challenges.
CO7: Applying DSP processor knowledge to various applications involves critical thinking to address real-world problems and optimize solutions.

PO4 Research-related skills and Scientific temper

CO1: Engaging in signal interpretation and processing involves research-related skills and a scientific temper to explore, analyze, and understand the principles of digital signal processing.
CO2: Implementation of efficient transforms and algorithms requires research skills to stay updated on advancements and a scientific temper to assess their applications in analyzing discrete-time signals.
CO3,CO4: Analyzing and solving problems related to the Discrete Fourier Transform (DFT) necessitate research-related skills and a scientific temper to delve into the theoretical foundations and practical applications.
CO5: Acquiring knowledge of Fast Fourier Transform (FFT) algorithms involves research skills to understand their development and scientific temper for critical evaluation and application.
CO6: Designing and implementing Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) filters require research-related skills and a scientific temper to explore various design approaches and evaluate their effectiveness.
CO7: Applying DSP processor knowledge in different applications demands research skills to adapt to diverse contexts and a scientific temper to assess the suitability and effectiveness of the applied solutions.

PO6 Personal and professional competence:

CO1: Developing competence in interpreting and processing signals reflects personal and professional growth, showcasing an individual's capability to handle complex tasks in the field of digital signal processing.
CO2: Implementing efficient transforms and algorithms demonstrates personal and professional competence, indicating the ability to apply theoretical knowledge to practical problem-solving.

CO3,CO4: Analyzing and solving problems related to the Discrete Fourier Transform (DFT) reflects personal and professional competence in dealing with mathematical and theoretical aspects of digital signal processing.
CO5: Acquiring knowledge of Fast Fourier Transform (FFT) algorithms showcases personal and professional competence in staying updated with technological advancements and applying them in signal analysis.
CO6: Designing and implementing IIR and FIR filters demonstrates personal and professional competence in applying signal processing concepts to real-world scenarios and engineering solutions.
CO7: Applying DSP processor knowledge in diverse applications reflects personal and professional competence in adapting technical skills to address challenges and contribute effectively to different domains.

PO9 Self-directed and Life-long learning:

CO1: Mastering the interpretation and processing of signals reflects a commitment to continuous learning, showcasing the ability to adapt and acquire new skills throughout one's professional journey.
CO2: Implementing efficient transforms and algorithms requires ongoing learning to stay abreast of advancements in the field, aligning with the self-directed and life-long learning aspect.
CO3,CO4: Analyzing and solving problems related to DFT and IDFT demonstrates a commitment to self-directed learning, as individuals strive to deepen their understanding and proficiency in solving complex mathematical challenges.
CO5: Acquiring knowledge of FFT algorithms signifies a commitment to self-directed learning, as individuals engage in continuous education to understand and apply advanced algorithms for signal analysis.
CO6: Designing and implementing IIR and FIR filters involves ongoing learning to explore innovative approaches and adapt to evolving technologies, aligning with the ethos of self-directed and life-long learning.
CO7: Applying DSP processor knowledge in diverse applications requires a commitment to continuous learning, staying updated with emerging trends and technologies to effectively contribute to various domains throughout one's professional journey.

ELE4304: Programmable Logic Controllers and Applications

Course Objectives:

1. To make awareness of programmable logic controller hardware.
2. To know working of timers and counters in PLC.
3. To familiarize programming in PLC.
4. To learn different modes of PLC programming.
5. To study some case studies using PLC.
6. To develop applications of PLC.
7. To learn concept of sinking and sourcing.

Course Outcomes:

1. Identify the main parts of a programmable logic controller.
2. Describe how a programmable logic controller is programmed.
3. Develop logic gate circuits from Boolean expressions and convert it to programming.
4. Write a Ladder Logic Program.
5. Describe switching elements on input/output modules.
6. Describe functions of programmable logic controller components.
7. Test a programmable logic controller Discrete Output device for correct response.

Unit 1: Introduction to PLC

PLC characteristics, operation, function, Types of PLC, Architecture Of PLC, Applications of PLC, PC v/s PLC, memory, Input/output module with reference to sink or source, output module relay, transistor, triac, power supply, signal conditioning, remote connections, networks, PLC product application range, selection of PLC, Examples of applications AC mains interfaces, PLC wiring, device wiring, 24V DC input interfaces, sourcing devices, sinking devices, output interface configurations and wiring

Unit 2: PLC Programming

Programming methods- Logic control elements (NOT,AND,OR,NAND,NOR etc), ladder diagrams, function blocks, statement list, programming a PLC, programming terminals, ladder relay instructions, ladder relay programming (digital gates, boolean expression, mux-demux, flip flop)

Unit 3: Timers, Counters and Registers

Types of timers, programming timers, off-delay timers, pulse timers, programming examples, forms of counter, programming, up and down counting, timers with counters, sequencer, data handling: registers and bits, data handling, arithmetic functions, closed loop control shift registers, ladder programs.

Unit 4: Case studies

Program development, safe systems, commissioning, fault finding, system documentation programs- temperature control, valve sequencing, conveyor belt control, control of a process, traffic lights controller, bottle filling control, alarm monitor program, car parking, vending machine, automatic stacking program, AC motor drive interface, elevator, water level controller.

Text /Reference Books:

1. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers Principles and Applications", Fifth Edition, Prentice Hall Publication, New Delhi, 2002.

2. L.A. Bryan, E.A. Bryan, "Proghrammable controllers theory and Implementations" second edition, An Industrial Text Company Publication.

3. W.Bolton, "Programmable Logic Controllers", Fifth Edition, Elsevier Publication

4. Gary Dunning, "Introduction To Programmable Logic Controllers", Third Edition.

5. John R. Hackworth, Frederick D. Hackworth, "Programmable Logic Controllers Programming Methods and Applications", Pearson Publication.

6. Frank D. Petruzella, "Programmable Logic Controllers", Third Edition, Tata McGraw Hill Education Private Limited, 2010.

7. John F. Kennedy "Programmable Controllers An engineer's guide" 3rd Newnes Publications.

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Students will demonstrate knowledge about understanding theoretical and practical Programmable Logic Controller over other microcontrollers and supervisory control systems.

CO2: Students will develop a software program using different PLC programming methods for different PLCs. for given Boolean Expression.

CO3: Students will develop a software program using different PLC programming methods for given Boolean Expression as well as develop a logic circuit.

CO4: Students will develop a ladder diagram for any Boolean equation or logic circuit as a part of a programme which is the result of theoretical and practical understanding of the programming method.

CO5: Students will develop knowledge about the switching elements at the input side and at the output side of the Programmable Logic controller.

CO6: Students will get a comprehensive knowledge about the functions of components of PLC that it is tiny computer which receives data through its inputs and send operating instructions through its outputs.

CO7: Students will execute the knowledge that PLC's job is to control a system's functions with the help of internal instructions programmed into itself.

PO2: Critical Thinking and Problem solving

CO2: Students will get the skill of critical thinking and evaluate the case using the programming methods in PLC.
CO3: Students will develop a logic circuit by identifying or simplifying the given Boolean equation and according to the situation, programming is carried out.
CO4: Students will be able to write a ladder logic for a given case study example or any problem statement.
CO5: Students will be able to identify the switching elements of PLC according to the input and output modules and make the circuit connections to design the solutions.
CO7: Students will be able to test and develop the systems having discrete output devices having the correct response.

PO4: Research-related skills and Scientific temper:

CO2: Student will be able to seek for research papers by analyzing the Programmable Logic Controller and the methods of programming with numerous industrial and scientific PLCs
CO3: Students will develop the programs using ladder diagram, structured texts, and functional block diagram and can be able to write the research papers having different cases.
CO5: Students will be able to formulate and test and describe the switching elements having connections from host PLC to remote I/O racks forming the special digital network.

PO5: Trans-disciplinary knowledge:

CO2: By getting knowledge about the programming of PLC, students will be able to create new conceptual, theoretical understandings which in future will advent to a routine issue.

CO3: Students will be able to develop a common routine complication into a methodological empathetic coordination.

CO5: Students will get knowledge about the input output modules and the switching elements transforming beyond the particular path to the prevailing problem.

CO6: Students will be able to know that operation of PLC has three stages as input, program execution and output. The programming can read the current position of inputs and outputs and also check if there is any need to modify and update.

PO6: Personal and Professional Competence

CO3: Students will be able to develop a logic gate circuit from a given Boolean expression anytime independently as well as in a group to carry interdisciplinary works according to the programming of PLC and thus motivating themselves to adapt skills as per the professional ethics.

PO8: Environment and Sustainability

CO7: Students will be able to understand effect of their solution over any problem solving study that it is necessary to have continuous solutions considering the environmental conditions.

PO9: Self-directed and Life-long learning

CO1: Students will gain the capability to identify and work on the main components of programmable logic controller independently.

CO3: Students will be able to develop a program in any method of programming a PLC from any Boolean equation or logic circuit which will make them an independent programmer of PLC in automation.

CO4: Students will get the knowledge about the ladder diagram drawings according the problem statement and also from any other case study without depending on each other as well as it can be teamwork to design a ladder diagram in the broadest context in these socio-technological changes.

CO6: Students will be able to function on PLC and its programming as a lifelong skill as an individual.

CO7: students will be able to test any discrete output device for its digital output that leads acquiring the capacity of individual and enduring civics technological variations.

ELE4305: Practical Course –V

Objectives:

1. To learn analog modulation techniques
2. To make students aware of various actuators
3. To learn various digital modulation techniques.
4. To learn different control system.
5. To learn various power Electronics Circuit.
6. To study different types of Motor.
7. To know the various power supply and source.

Course Outcomes: On completion of the course, students will be able to

CO1. Design different analog Modulation Techniques.

CO2. Design Various control system Application.

CO3. Design Various Power Electronic Circuit.

CO4. Designing different motor controlling techniques.

CO5. Student will able to design digital Modulation and demodulation system

CO6. Student will able to design ON-OFF Controller system

CO7. Understand the operation of various power supplies.

Laboratory Practical: Any 10 Practicals from following sections

Advanced Communication Electronics

1. Design of AM/FM transmitter and receiver
2. Delta modulation
3. Design PCM encoder/ decoder system
4. Design of FSK transmitter and receiver
5. Time division Multiplexing
6. Telemetry Applications
7. Varactor diode characteristics and its application in FM
8. Design of FSK transmitter and receiver
9. Design of Binary Phase Shift Keying

Control Systems and Process Instrumentation

1. Signal conditioning circuits for analog controller
2. Design and implement ON-OFF Controller
3. Design and implement P / PI / PID controller
4. To study the position / velocity control of dc servo motor
5. Flow control using solenoid valve
6. Study of optical position encoder

Advanced Power Electronics

1. DC motor speed /AC motor speed control/ Stepper motor control

2. Practical based on Inverter.
3. Design single phase on-off controller.
4. Study of thyristor its characteristics.
5. Study of Commutation method of SCR.
6. Design Dual Power supply using Transformer.
7. Design Variable Power supply.

Mechatronics

1. Study of DC servo motor/BLDC motor.
2. Study of PMDC motor toque speed characteristics
3. Study of AC servo motor, its speed control/position control
4. Set up a flow control system using suitable flow sensor and actuator
5. study of actuators and their driving circuit (solenoids, motors etc.)
6. Study digital sensor

Activity: Industrial Visit / Hobby project (equivalent to practical experiments)

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

Justification for the mapping

PO1: Disciplinary Knowledge

The course outcomes (COs) contribute to the development of students' disciplinary knowledge in electrical and electronics engineering. For example, CO1, CO5 require to know the modulation techniques and design the necessary circuit. CO2, CO4 and CO6 required getting knowledge of controlling techniques. CO3 and CO7 require students to understand concepts of power supply.

PO2: Critical Thinking and Problem Solving

The entire COs contributes to the development of students' critical thinking and problem-solving skills. For example, CO1 and CO5 require students to think critically about operation of analog and digital modulation circuit. CO2, CO4 and CO6 require students to think critically about how to design analog or digital circuit for controlling dedicated application and its response. CO3 and CO7 require students to think critically about the power supply design.

PO3: Social competence

CO2, CO3, CO4, CO6 and CO7: contributes to the development of students' for problem-solving skills. They think the solution and design circuit for social need in automation, controlling and power supply design.

.**PO4: Research-related skills and Scientific temper**

The entire COs contributes to the development of students' research-related skills and scientific temper. CO1, CO2, CO3, CO4, CO5 CO6 and CO7 require for students to think to design circuit for problem solving and formulate the hypothesis.

PO5: Trans-disciplinary knowledge

CO2, CO3, CO4, CO6 and CO7 contribute to the development of students' trans-disciplinary knowledge. Student will able to design system for practical problems solve interdisciplinary field.

PO6: Personal and professional competence

CO3, CO4, CO5 and CO6 all contribute to the development of students' personal and professional competence. Students to develop their ability to work independently or as a team to solve real-world problems. Students develop their skills for starting own start-up in electronics design. Students use their knowledge to develop suitable solution for interdisciplinary field such as physics, chemistry, agriculture, industrial, botany etc.

PO7: Effective Citizenship and Ethics

CO2, CO3 and CO6 contribute to the development of automation system; controlling or security system design for understanding the ethical considerations in technology aligns for effective citizenship.

PO8: Environment and Sustainability

CO2, CO3, CO4, CO6 and CO7 required to student for thinking development of analog or digital circuit for simplified practical problems for soil, water or environment parameter monitoring and easy handling laboratory instruments.

PO9: Self-directed and Life-long learning

CO2, CO4 and CO6 all contribute to the development of students' ability to engage in self-directed and life-long learning. For example, the entire COs requires students to develop their ability to learn new concepts of designing and apply them to new problems. It is lifelong learning due to hands on practical.

ELE4306: Practical Course –VI (4 Credits)

Objectives:

1. To learn ARM Cortex-M3.
2. To introduce Raspberry pi.
3. To make the students aware of programmable logic controller hardware
4. Identify different components of PLC.
5. To be able to apply the MATLAB Programme to digital processing problems and Presentations
6. To understand basic of RTOS
7. To understand RTOS Programming

Course Outcomes: On completion of the course, students will be able to

1. Design embedded applications with operating system support
2. Design Raspberry pi python code.
3. Develop PLC ladder programs for different applications.
4. Design and implement IIR filters and FIR filters
5. Design of RTOS programming.
6. Develop various code for ARM Controller
7. Use of various software.

Computer - Microcontroller Laboratory: Any 10 Practicals from following sections

Group I- Advanced Embedded Systems

1. Interfacing Alphanumeric LCD to 16/32 bit microcontroller
2. Interfacing key board to 16/32 bit microcontroller
3. Programming ADC of 16/32 bit microcontroller
4. Programming DAC of 16/32 bit microcontroller
5. Programming UART of 16/32 bit microcontroller
6. Implementation of priority based execution of 3 task using RTOS
7. Blink an LED using Raspberry Pi and Python
8. Interfacing 16×2 LCD with Raspberry Pi
9. Controlling a DC Motor with Raspberry Pi

Group II- Digital Signal Processing

1. Generation of signals- Impulse, Step, Exponential and Ramp functions
2. Design of FIR filter, Design of IIR filter
3. Find DFT and IFT of given Example
4. Linear and circular convolution
5. To design low pass/ band pass filter using MATLAB.
6. To generate rectangular, hamming, hanning,blackman and kaiser window usingMATLAB.
7. Implementation of Decimation Process / Interpolation Process

Group III:-Programmable Logic Controllers and Applications

1. Relay programming (all logic gates, boolean equation like multiplexer, demultiplexer, encoder, decoder, latch etc.)
2. Temperature controller
3. Conveyor belt control
4. Alarm monitor program
5. Vending machine
6. Water level controller

Group IV:- Wireless Sensor Networks

1. Study of 802.15.4-interfacing and configuration
2. Setting up communication between 2 zigbee nodes
3. Home automation- related experiments
4. Study of effect of various modes of Microcontrollers on Network performance.
5. Interfacing Bluetooth / wifi module

Group V:- Communication Experiments using MATLAB

1. Phase shift keying (PSK)
2. Generation and reception of BPSK
3. Generation and reception of FSK
4. Generation and reception of QPSK
5. Continuous Phase FSK

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

Justification for the mapping

CO1: This CO aligns with the need for disciplinary knowledge as it involves understanding the integration of hardware and software for embedded applications.

CO2: Designing code for Raspberry Pi requires disciplinary knowledge in embedded systems and programming.

CO3: Developing ladder programs for PLC involves disciplinary knowledge in control systems and automation.

CO4: Designing and implementing filters require disciplinary knowledge in signal processing and digital signal processing.

CO5: Designing RTOS programming involves disciplinary knowledge in real-time systems and operating systems.

CO7: Utilizing various software involves disciplinary knowledge in software tools and applications.

PO2: Critical Thinking and Problem Solving

CO1 to CO7 (Except CO6): All course outcomes involve critical thinking and problem-solving skills. Designing embedded applications, programming for Raspberry Pi, developing PLC ladder programs, designing filters, programming RTOS, developing code for ARM controllers, and using various software tools all require analytical thinking and problem-solving abilities.

PO3: Social Competence

CO1: This CO aligns with the need for social competence as it involves understanding the integration of hardware and software for embedded applications.

CO2: Designing code for Raspberry Pi requires disciplinary knowledge in embedded systems and programming.

CO4: Designing and implementing filters require disciplinary knowledge in signal processing and digital signal processing.

PO4: Research-related Skills and Scientific Temper

CO1 to CO6:All course outcomes involve research related problem-solving skills. Designing embedded applications, programming for Raspberry Pi, developing PLC ladder programs, designing filters, programming RTOS, developing code for ARM controllers, and using various software tools all require research related skills.

P05: Trans-disciplinary Knowledge

CO1: This CO aligns with transdisciplinary knowledge as it involves understanding the integration of hardware and software for embedded applications.

CO2: Trans-disciplinary knowledge is encouraged as Raspberry Pi finds applications in various domains

CO4: Designing and implementing filters require Trans disciplinary knowledge in signal processing and digital signal processing.

CO6: Developing code for ARM controllers requires Trans disciplinary knowledge in computer architecture and embedded systems.

PO6: Personal and Professional Competence

CO1: This CO aligns with the need for personal and professional competence as it involves understanding the integration of hardware and software for embedded applications

CO3: Mastering PLC ladder programming is a key competence in the professional development of engineers.

PO7: Effective Citizenship and Ethics

CO1: This CO aligns with effective citizenship as it involves understanding the integration of hardware and software for embedded applications.

CO2: effective citizenship and ethics knowledge is encouraged as Raspberry Pi finds applications in various domains

CO4: Designing and implementing filters require effective citizenship and ethics knowledge in signal processing and digital signal processing.

CO7: Utilizing various software involves ethics knowledge in software tools and applications.

PO8: Environment and Sustainability

CO1: This CO aligns with Environment and Sustainability as it involves understanding the integration of hardware and software for embedded applications

CO4: Designing and implementing filters require Environment and Sustainability in signal processing and digital signal processing

PO9: Self-directed and Life-long Learning

CO1, CO4, CO7: course outcomes encourage a self-directed and lifelong learning approach as technology in these areas evolves, requiring adaptability