Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

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

2019 Pattern

Semester	Paper Code	Title of Paper	No. of Credits
II	ELE4201	Applied Electromagnetics, Microwaves and Antennas	4
	ELE4202	Instrumentation and Measurement techniques	4
	ELE4203	Advanced Embedded System Design	4
	ELE4204	Foundation of Semiconductor Devices	3
	ELE4205	Practical Course –I	4
	ELE4206	Practical Course –I	4
	ELE4207	PLE	2

SYLLABUS (CBCS) FOR M.Sc. I. Electronic Science (w.e. from June, 2019)

Academic Year 2019-2020

Class : M. Sc. I (Semester- II)

Paper Code: ELE4201

Paper : I Title of Paper : Applied Electromagnetics, Microwaves and Antennas
Credit : 4 No. of lectures: 60

Objectives:

1. To introduce to students the concepts of electromagnetics
2. To understand the theory of transmission lines.
3. To understand the theory of Wave guide.
4. To study various parameters of antennas
5. To study various methods of generation of microwaves
6. To Study Different Antenna types.
7. To study various parameters of antennas

Course Outcomes:

By the end of the course ,students will be able to

CO1. Concept of Electromagnetic Waves.
CO2. Various types of transmission line.
CO3. Solve problem using Smith Chart.
CO4. Working of OFC
CO5. Test and examine the phenomena of wave propagation in different media and its interfaces.
CO6. Design different antennas based on their characteristics for different applications.
CO7. Understanding various method of generation of microwaves

Prerequisite: Physical quantities as vectors, concept of gradient, curl, and divergence, concept of rotation operator, covariant and contra-variant vectors, line, surface and volume – integrals, Gauss and Stokes theorem complex plane, polar form of complex number, complex functions, Cauchy-Riemann conditions, orthogonal functions and relation with Laplace equation

Unit-1: Electromagnetic Waves:-

Review of Maxwell's equations and their meaning, continuity equation, electric and magnetic wave equations in time domain and frequency domain, wave propagation in conducting and non-conducting media, skin depth and high frequency propagation, boundary conditions at the interface between two mediums, Poynting theorem and its applications

Unit-2: Principles of transport of electromagnetic energy Transmission Lines:-

Different types of transmission lines, two wire transmission line, lumped and distributed parameters, transmission line equations for voltages and currents using circuit theory and field theory, characteristic impedance, propagation constants, attenuation and phase constants, phase velocity, reflection and transmission coefficient, SWR, line impedance, normalized impedance and admittance, Numerical exercises using circuit and Phasor theory, Smith chart construction and applications, single stub and double stub matching, shielding of transmission lines. Micro stripline – Introduction to striplines, characteristic impedance, effective dielectric constant, dielectric ohmic and radiation losses in microstripline, Q-factor of microstripline, different types of microstriplines such as parallel, coplanar, shielded striplines Waveguides – concept of cut-off frequency, guide impedance, phase velocity, guide wavelength for TE and TM modes, Applications to TE mode in rectangular waveguide, power losses in a rectangular waveguide, circular waveguide, optical fiber- Principal of operation and construction.

Unit-3: RF, microwave devices and applications :-

Applications of RF: heating, plasma etching, sputter deposition, EMI shielding Microwave frequencies and frequency bands for different applications, Absorption of microwave by atmospheric constituents, microwave system, generation of microwaves, microwave transistors and tunnel diodes, microwave FETs, MESFET and MOSFETs, Gunn effect diode, IMPATT diode, magnetron oscillator, Reflex Klystron Oscillator, monolithic microwave integrated circuits, microwave waveguides and resonant cavities and components, passive microwave devices -Terminator, variable short circuits, rotary, cut-off, nonreciprocal and ferrite attenuators, Faraday rotation, directional coupler, microwave guide junction , circulators, Application of microwaves –microwave oven, long distance communication

Unit-4: Electromagnetic Radiation:

Potentials of electromagnetic fields, retarded potential, radiation from oscillating dipole, concept of near zone and radiation zone, radiation resistance, Antenna Parameters: gain, directivity, power, aperture, Friis equation, radiation pattern 18 Application Areas: antenna temperature, Signal to Noise Ratio (SNR), remote sensing, RADAR equation Antennas Types: $\lambda/2$ antenna, antenna arrays, horn antennas, parabolic dish antennas, End fire antenna – Yagi Uda, patch antenna, microstrip antennas EMI and EMC.

Text / Reference Books:

1. Microwave Devices and Circuits, Samuel Y. Liao, PHI, 3rd Edition, 2002.
2. Principles of Electromagnetics, N. Sadiku, Oxford University Press.
3. Electromagnetics with Applications, Kraus and Fleiseh, McGraw Hill, 5th Edn, 1999.
4. Electromagnetics, J.D. Kraus, 4th Edn, McGraw Hill, 1992.

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 the concept of electromagnetic waves contributes to disciplinary knowledge in the field of electromagnetic theory.

CO2: Knowing various types of transmission lines enhances disciplinary knowledge in the area of communication systems and signal transmission.

CO5: Testing wave propagation phenomena in different media contributes to disciplinary knowledge in wave propagation.

CO7: Understanding microwave generation methods contributes to disciplinary knowledge in microwave engineering.

PO2: Critical Thinking and Problem Solving

CO1: Analyzing the behavior of electromagnetic waves requires critical thinking and problem-solving skills.

CO2: Selecting the appropriate transmission line for specific applications involves critical thinking and problem-solving skills.

CO3: Utilizing the Smith Chart for problem-solving requires critical thinking and analytical skills.

CO5: Understanding wave propagation is crucial for Critical Thinking and Problem Solving.

CO7: Understanding microwave generation methods contributes to Critical Thinking and Problem Solving.

PO3: Social Competence

CO1: Understanding the concept of electromagnetic waves contributes to Social Competence

CO2: Knowing various types of transmission lines enhances Social Competence in the area of communication systems and signal transmission

CO5: Understanding wave propagation is crucial for Social Competence.

PO4: Research-related Skills and Scientific Temper

CO1 to CO6: All co provide Research-related Skills and Scientific Temper.

P05: Trans-disciplinary knowledge

CO1: Analyzing the behavior of electromagnetic waves requires Trans-disciplinary knowledge

CO2: Selecting the appropriate transmission line for specific applications Trans-disciplinary knowledge.

CO4. Working of OFC include Trans-disciplinary knowledge

CO6. Design different antennas based on their characteristics for different applications provide different Trans-disciplinary knowledge

P06: Personal and professional competence

CO1: Analyzing the behavior of electromagnetic waves requires Personal and professional competence.

CO3: Using the Smith Chart involves Personal and professional competence.

P07: Effective Citizenship and Ethics

CO1: Understanding the concept of electromagnetic waves contributes Effective Citizenship and Ethics

CO2: Knowing various types of transmission lines enhances Effective Citizenship and Ethics

in the area of communication systems and signal transmission.

CO4. Working of OFC include Effective Citizenship and Ethics

PO8: Environment and Sustainability:

CO1: Understanding the concept of electromagnetic waves contributes to Environment and Sustainability:

CO4. Working of OFC include to Environment and Sustainability:

PO9: Self-directed and Life-long learning

CO1: Understanding the concept of electromagnetic waves contributes to Self-directed and Life-long learning

CO4. Working of OFC include to Self-directed and Life-long learning

SYLLABUS (CBCS) FOR M.Sc. I. Electronic Science (w.e. from June, 2019)

Academic Year 2019-2020

Class : M. Sc. I (Semester- II)

Paper Code: ELE4202

Paper : II Title of Paper : Instrumentation and Measurement techniques.

Credit : 4 No. of lectures: 60

Learning Objectives:

1. To understand the configurations and functional descriptions of measuring instruments.
2. To understand the basic performance characteristics of instruments
3. To understand the working principles of various types of sensors and transducers and their use in measuring systems.
4. To study the techniques involved in various types of instruments.
5. To understand the relevance of electronics with other disciplines.
6. To understand the application of Electronics in biomedical application.
7. Ability to bring out the important and modern methods of imaging techniques and their analysis.

Course Outcome :

CO1. To Know the various types instruments and measurement system.
CO2. Ability to find Instrument characteristics and error.
CO3. Working principles of various types of sensors and transducers, Actuators Instruments.
CO4. Ability to bring out the importance of Sensors for monitoring controlling applications.
CO5. Ability to interface sensors actuators for dedicated applications.
CO6. To know the role of technology in biomedical applications.
CO7. Students are able to know the bio potential, ECG, EEG & EMG.

Unit1: Introduction to sensor and Transducer (15L)

Definition, Types of sensor, classification, Need of Sensors. Static and dynamic characteristics: Accuracy, Precision, Resolution, Threshold, Sensitivity, Hysteresis, loading effect, linearity, dead zone. Transducer: Active and passive transducer, Methods of transduction, primary sensing elements and transducers, electrical transducers, classification of transducers Errors in measurement: Types of Errors - gross, systematic, environmental errors, Systematic errors, computational error, personal error etc.

Unit 2: Motion Measurement (15L)

Motion and dimensional measurement: relative displacement- translational and rotational, resistive potentiometers, resistance strain gauge, differential transformers- LVDT & RVDT, piezoelectric transducers, digital displacement transducers (translational and rotary encoders), ultrasonic transducers, Hall effect sensor, LVDT and synchros Relative velocity: translational and rotational, stroboscopic methods, translational–velocity transducers (moving coil and moving magnet pickups) Relative acceleration measurements: seismic (absolute) displacement pickups, Seismic (absolute) velocity pickups, seismic (absolute) acceleration pickups (Accelerometers)

Unit 3: Process Parameter Measurement **(15L)**

Force, Torque and Shaft power: standards and calibration, basic methods of Strain gauge, digital system, load cell, torque measurement on rotating shafts Pressure and Sound Measurement: dead weight gauges and manometers, low pressure measurement - Mcload gauge, Knudsen gauge Primary devices: Bellows, Bourdon tube, Diaphragms, Capsule. Sound level meter, microphone, and capacitor microphone Flow measurement: Pitot-static tube, Yaw tube, hot wire and hot film anemometers, Flow Rate- rotameter, turbine, ultrasonic flow meter, electromagnetic flow meters Temperature and Heat Measurement Transducers: standards and calibration, Bimetallic strips, thermometers, pressure thermometers, RTD, thermocouples, thermistors, application circuits, LM35

Radiation Fundamentals: detectors, optical pyrometers, IR imaging systems, heat Flux sensing-slug type sensors, Gorden gauge

Unit4: Biomedical based instrumentation system **(15L)**

Fundamentals of medical Instruments: Role of Technology in medicine, Development in biomedical insterumentation medical devices. Bioelectric signals and electrodes: Electrical and mechanical activity of Heart, ECG measurement, Cardiac analysis, Normal and abnormal ECG, Generation and measurement of EMG Signal. Design of ECG amplifier. Imaging Techniques: X-ray generation, X-ray tube and its control CT scan –Scanning System and application Ultrasonic Imaging: Modes of Scanning and their application. MRI: Concept and image generation block diagram and its application.

Reference books:

1. Measurement Systems, Applications and Design, Ernest O. Doeblin and Dhanesh N. Manik, 5th Edition, Tata McGraw Hill.
2. A Course in Electrical and Electronic Measurements and Instrumentation By A.K.Sawhney, Dhanpat Rai & Co.
3. Modern Electronic Instrumentation and Measurements Techniques, Cooper and Helfrick, PHI.
4. Biomedical instrumentation and measurement, R.Natrajani.
5. Biomedical Instrumemtation, R.S.Khandpur, 3rd edition.

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Students will able to demonstrate use instruments for measurement techniques precisely and use for various parameter measurements.

CO2: Students will develop deep understanding of instrument characteristics, handling and reducing errors in instruments.

CO3,4: Students will master in demonstrate the use of sensors, transducers, actuators and it applications.

CO5: Students will develop knowledge to demonstrate the interfacing of sensor to develop system for dedicated applications.

CO6,7: Students will demonstrate the use of modern technology in biomedical applications.

PO2: Critical Thinking and Problem Solving

CO1,2: Students will apply their knowledge for selecting instrument for reducing error, good performance.

CO3,4,5: Students will think to develop specific instrument using sensor, transducer and actuators for dedicated application for solving complex problem.

CO6,7: Students will increase thinking ability to develop experimental skill to design electronics system for biomedical applications.

PO3: Social competence

CO3 and CO4: Students will able to use various instruments, sensors and transducers for industrial, agriculture, medical, automobile or any other relevant application for monitoring and controlling.

CO7: Student will apply the idea to exhibit the hardware design for medical field solve real-world problems.

PO4: Research-related skills and Scientific temper

CO2: Student develops their ability to handle instruments precisely for research related skill and scientific application.

CO1,5: Students will able to use scientific instruments for result analysis and standardization for research related skill.

CO6,7: Students apply their knowledge for biomedical application.

PO5: Trans-disciplinary knowledge

CO2: Student will use their knowledge for designing electronic system for solving practical problems in physics, chemistry, botany and other relevant subject.

CO4,5: It is useful for development of monitoring and controlling electronic system for biomedical application.

CO7: It is useful for development of electronic system for biomedical application.

PO6: Personal and professional competence

CO3,5,7: 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.

PO8: Environment and Sustainability

CO4-5: Student will think to develop system for weather monitoring system which helps various applications, automation system for agriculture, automobile industry and energy conservation.

PO9: Self-directed and Life-long learning

CO3,4,5,7: Student will think the technical solution for real-world problems and start-up in electronics design for various applications. It is lifelong learning due to technology in automobile, agriculture, biomedical etc.

SYLLABUS (CBCS) FOR M.Sc. I. Electronic Science (w.e. from June, 2019)

Academic Year 2019-2020

Class : M. Sc. I (Semester- II)

Paper Code: ELE4203

Paper : II **Title of Paper : Advanced Embedded System Design**
Credit : 4 No. of lectures: 60

Objectives:
1. To understand the basics of embedded system
2. To learn communication standards and protocols and RTOS
3. To understand the architecture of PIC and AVR 8-bit microcontrollers
4. To learn embedded C and assembly language programming
5. To learn real interfacing devices to microcontroller.
6. To introduce real life modules.
7. To study interfacing of serial communication with PIC and AVR.

Course Outcomes:

By the end of the course, students will be able to:
CO1. Understand the internal architecture and interfacing of different peripheral devices with PIC and AVR 8 bit Microcontrollers.
CO2: Analyze and develop embedded hardware and software development cycles and tools.
CO3: Evaluate and understand different concepts of sensors, memory interface, and types of communication protocols.
CO4: Design and develop programming skills in embedded systems for various applications.
CO5: Interface external devices to PIC and AVR microcontroller.
CO6: Understand the concept of embedded system design.
CO7: Explain serial communication interfacing using PIC and AVR.

Unit-1: Introduction to Embedded System and Bus Standards (15L)

Embedded System: components, examples, development cycle of embedded system, embedded System Development Environment - algorithm, flow chart, IDE, ICE, programmer
Communication Protocols: I2C bus- specification, general characteristics, bus signals, address mechanism
Serial Peripheral Interface (SPI): specifications, master slave configuration,
Controller Area Network (CAN): specifications, basic concepts, frame types, bus signals, error handling and addressing

Unit-2: AVR Microcontroller (15L)

Architecture (Atmega16), instruction set, addressing modes, memory organization, timers, I/O, ADC, interrupts, serial communication
Design of General Purpose Target Board: reset, oscillator circuit, Basic Assembly Programs: arithmetic, logical, code converter, I/O programming
C Programs: I/O ports, timer, serial communication, PWM, ADC, interrupts, Inter-Integrated

Circuit (I2C).
Real world interfacing with the microcontrollers and programming in C: DAC, LED, SSD, dot matrix display, and LCD displays (text and graphic), keyboard and motors, RTC, EEPROM,

Unit-3: PIC Microcontroller (15L)

Architecture (PIC18F4550, 18F458), instruction set, addressing modes, memory organization, timers, I/O, ADC, interrupts, serial communication
Design of General Purpose Target Board: reset, oscillator circuit, derivatives of PIC Basic Assembly Programs: arithmetic, logical, code converter, block data transfer, I/O programming
C Programs: I/O ports, Timer, interrupts, I2C, serial communication, PWM
Real world interfacing with the microcontrollers and programming in C: DAC, LED, SSD, dot matrix display, and LCD displays (text and graphic), keyboard and motors, RTC, EEPROM, DAC and ADC.

Unit -4: Fundamental of Real Time Operating System (15L)

Concept of Real time, Characteristics, Hard and Soft real time system, Structure of RTOS, RTOS kernel, Kernel Objects, Services of Scheduler, Task, Task structure, types of task, Task management
Scheduling Algorithm- Task Scheduling Algorithm, FIFO, Round Robin Scheduling Algorithm, Priority based preemptive scheduling

Text / Reference Books:

1. AVR Microcontroller and Embedded Systems using Assembly and C, Mazidi and Naimi,
2. Pearson education, 2011.
3. Embedded/ Real Time System - Concept Design Programming, KVVK Prasad
4. Embedded C Programming and the Atmel AVR, Barnett, Larry D. O'Cull and Sarah A.
5. Cox, Delmar, Cengage Learning, 2007.
6. PIC Microcontroller and Embedded Systems, Mazidi, Mckinlay and Causey, Pearson
7. Education.
8. C Programming for Embedded Systems, Kirk Zurell, PearsonEducation.
9. Programming in C, Stephen Kochan, HaydenBooks/Macmilla

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Students gain a deep understanding of microcontroller internal architecture and peripheral interfacing, aligning with the program's focus on developing solid disciplinary knowledge in embedded systems.
CO2: By analyzing and developing embedded hardware and software cycles, students enhance their disciplinary knowledge in embedded systems, aligning with the program's objectives.
CO3: Understanding sensors, memory interfaces, and communication protocols contributes to students' disciplinary knowledge in embedded systems, fulfilling the program's emphasis on core concepts.
CO4: Developing programming skills for embedded systems aligns with the program's goal of imparting disciplinary knowledge in embedded systems design and implementation.
CO5: Teaching students to interface external devices with microcontrollers enhances their disciplinary knowledge in hardware integration, supporting the program's objectives.
CO6: Grasping the concept of embedded system design aligns with the program's focus on disciplinary knowledge, preparing students for comprehensive understanding and application in embedded systems design.
CO7: Explaining serial communication interfacing with microcontrollers aligns with the program's emphasis on disciplinary knowledge in communication protocols and reinforces the students' understanding of embedded systems.

PO2: Critical Thinking and Problem solving

CO1: Analyzing microcontroller architectures and peripheral interfacing requires critical thinking skills, aligning with the program's focus on fostering critical thinking and problem-solving abilities.
CO2: Involves critical thinking and problem-solving, contributing to the program's emphasis on cultivating these skills.
CO3: Evaluating sensor concepts, memory interfaces, and communication protocols demands critical thinking, aligning with the program's objective of fostering critical thinking and problem-solving abilities.
CO4: Necessitate critical thinking and problem-solving skills, supporting the program's focus on cultivating these abilities.
CO5: Interfacing external devices with microcontrollers involves problem-solving and critical thinking, aligning with the program's emphasis on developing these skills.
CO6: Grasping the concept of embedded system design requires critical thinking, contributing to the program's goal of cultivating critical thinking and problem-solving skills.
CO7: Involves critical thinking, supporting the program's objective of developing critical thinking and problem-solving abilities.

PO3: Social competence

CO1: Collaborative understanding of microcontroller internals and peripheral interfacing fosters social competence, as it encourages teamwork and shared learning experiences within the program.
CO2: Emphasizing teamwork and shared problem-solving skills.
CO3: Promotes social competence by encouraging shared understanding and knowledge exchange among students.
CO4: Emphasizing teamwork and collective problem-solving in application development.

CO5: Emphasizing teamwork and shared experiences in hardware integration.
CO6: Promoting teamwork and shared insights into the broader aspects of system design.

PO4: Research-related skills and Scientific Temper

CO1: Fosters research-related skills and a scientific temper, aligning with the program's emphasis on cultivating research capabilities.
CO2: Analyzing and developing embedded hardware and software cycles requires a research-oriented approach, contributing to the program's focus on research-related skills and a scientific temper.
CO3: Involves a research-oriented mindset, aligning with the program's goal of developing research-related skills and a scientific temper.
CO4: Designing and developing programming skills for embedded systems demands a research-oriented approach, supporting the program's emphasis on cultivating research skills and a scientific temper.
CO5: Encourages a research-oriented mindset, contributing to the program's focus on developing research-related skills and a scientific temper.
CO6: Aligning with the program's goal of fostering research-related skills and a scientific temper.
CO7: Explaining serial communication interfacing with microcontrollers requires a research-oriented mindset, supporting the program's emphasis on developing research-related skills and a scientific temper.

PO5 :Trans-disciplinary knowledge

CO1: Grasping microcontroller architecture and interfacing with peripherals involves trans-disciplinary knowledge, aligning with the program's focus on developing a broad understanding of various disciplines within embedded systems.
CO2: Analyzing and developing embedded hardware and software cycles requires a trans-disciplinary approach, contributing to the program's goal of fostering knowledge that spans multiple disciplines in embedded systems.
CO3: Evaluating sensor concepts, memory interfaces, and communication protocols involves trans-disciplinary knowledge, aligning with the program's emphasis on a comprehensive understanding of various concepts.
CO4: Designing and developing programming skills for embedded systems demand trans-disciplinary knowledge, supporting the program's objective of imparting knowledge that extends beyond a single discipline.
CO5: Contributing to the program's focus on developing a holistic understanding of various aspects in embedded systems.
CO6: Aligning with the program's goal of providing students with a broad understanding of different facets of embedded systems.
CO7: Supporting the program's emphasis on a comprehensive understanding of communication protocols across disciplines.

PO6: Personal and professional competence

CO1: Enhances personal and professional competence, aligning with the program's focus on individual and professional development.
CO2: Contributes to personal and professional competence by honing skills crucial for a successful career in the field of embedded systems.

CO3: Fosters personal and professional competence, enhancing students' abilities to apply their knowledge in practical scenarios.
CO4: Enhances personal and professional competence, equipping students with the practical skills needed for professional success.
CO5: Promotes personal and professional competence by emphasizing teamwork and shared experiences in hardware integration.
CO6: Contributes to personal and professional competence, providing a solid foundation for tackling complex design challenges in a professional setting.
CO7: Explaining serial communication interfacing with microcontrollers enhances personal and professional competence, as it requires effective communication skills and the ability to convey technical concepts.

PO7: Effective Citizenship and Ethics:

CO1: Emphasizes ethical practices in technology, aligning with the program's objective of nurturing effective citizenship and ethical behavior in the field of embedded systems.
CO2: Involves ethical considerations, promoting effective citizenship by encouraging responsible practices in the design and development of embedded systems.
CO3: Fosters effective citizenship, emphasizing the responsible use and understanding of technology.
CO4: Instilling ethical considerations in the application of these skills, encouraging responsible use of technology.
CO5: Emphasizing ethical considerations and responsible practices in hardware integration.
CO6: Involves ethical considerations, promoting effective citizenship by instilling a sense of responsibility in designing systems that adhere to ethical standards.
CO7: Aligning with the program's emphasis on effective citizenship and ethical behavior in technology.

PO8: Environment and Sustainability:

CO1: Aligning with the program's emphasis on awareness of environmental impact in embedded systems.
CO2:Emphasis on energy-efficient practices aligns with environmental sustainability objectives, promoting responsible resource utilization.
CO3: Fosters sustainability awareness, aligning with the program's focus on environmentally conscious embedded systems.
CO4: Supports environmental sustainability, emphasizing responsible programming practices to minimize ecological impact.
CO7: Explaining serial communication interfacing with microcontrollers while considering energy-efficient communication practices supports environmental sustainability, aligning with the program's emphasis on responsible communication protocols.

PO9: Self-directed and Life-long learning

CO1: Fostering a mindset of continuous learning aligned with the program's emphasis on life-long learning.
CO2: Encouraging students to seek and apply knowledge independently, supporting life-long learning goals.
CO3: Emphasizing the importance of continuous learning in the evolving field of embedded systems.

CO4: Instilling a commitment to life-long learning as students adapt to new technologies and applications.
CO5: Students engage in hands-on exploration, fostering a commitment to life-long learning in the field of hardware integration.
CO6: Encouraging a continuous exploration of design principles and practices throughout one's professional life.
CO7: Emphasizing the importance of staying updated on communication protocols, contributing to life-long learning in the domain.

SYLLABUS (CBCS) FOR M.Sc. I. Electronic Science (w.e. from June, 2019)

Academic Year 2019-2020

Class : M. Sc. I (Semester- II)

Paper Code: ELE4204

Paper : II **Title of Paper :** Foundation of Semiconductor Devices

Credit : 3 No. of lectures: 60

Course Objectives:

1. To introduce crystal structure with reference to semiconductors
2. To introduce quantum and statistical mechanics
3. To provide students with a basic understanding of semiconductor materials and their properties, including concepts like energy bands, charge carriers, and doping.
4. Operating principles of modern semiconductor devices
5. To understand the theory and characteristics of semiconductor devices.
6. Determine the band structure of semiconductors when supplied with basic materials properties and applying their knowledge of quantum mechanics.
7. To understand the optical devices.

Course Outcomes:

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

CO1. Understand the concept of Quantum and statistical mechanics.
CO2. Students able to understand semiconductor fundamentals, including concepts related to energy bands,
charge carriers, and crystal structures.
CO3. Students should be able to explain the operating principles of key semiconductor devices, such as diodes, bipolar junction transistors, and field-effect transistors.
CO4. Students should understand the basic processes involved in semiconductor device.
CO5. Understand the characteristics of semiconductor devices.
CO6. Students should be familiar with the various applications of diode, transistor and FETs
CO7. Understand the function of solar cell.

Unit-1: Theory of solids, quantum and statistical mechanics (15L)

Crystal structure of solids: types of solids, Semiconductor materials, basics of crystallography, space lattice, unit cell, Crystal structures, atomic bonding,Miller indices, imperfections and impurities in solids, methods for semiconductor crystal growth.

Quantum Theory of solids: Principles of quantum mechanics, Schrodinger wave equation and Applications of Schrodinger's wave equation for bound state potential problems, Allowed & forbidden energy bands, The Kronig–Penney Model, electrical conduction in solids, extensions to three dimensions

Statistical mechanics: Statistical laws, Fermi-Dirac probability function, the distribution function and the Fermienergy

Unit-2: Physics of semiconductors (15L)

Semiconductor in equilibrium: Dopant atoms and energy levels, extrinsic semiconductors, Statistics of donors and acceptors, charge neutrality, position of Fermi energy level.

Carrier transport phenomena: charge, effective mass, drift current density, conductivity, carrier diffusion, graded impurity distribution, Hall effect.

Non-equilibrium excess carriers in semiconductors: Carrier generation and recombination, characteristics of excess carriers, ambipolar transport, quasi-Fermi energy levels, excess carrier lifetime, surface effects

Unit-3: Basics of Semiconductor Devices (15L)

Diode: Fabrication process, Junction terminologies of PN junction diode, junction capacitance, C-V characteristics, Qualitative and Quantitative analysis, diode equation, Reverse-bias breakdown, Transient response, Poisson's equation BJT: Fabrication process, Terminology, electrostatics and performance parameters, EberMoll model, Two port model, hybrid – pi model, Modern BJT structures – polysilicon emitter BJT, Hetero junction bipolar transistor(HBT) FETs: JFET and MESFET - Junction terminologies, characteristics MOSFET: Fundamentals, Capacitance- voltage characteristics, I-V characteristics, Special semiconductor devices-Optical devices, Solar cells, Photodetectors

Text / Reference Books:

1. Semiconductor Physics and Devices Basic Principles, Donald A. Neamen, TMH, 3rd Edition(2003)
2. Semiconductor Device fundamentals, Robert F. Pierret, PearsonEducation
3. Solid State Electronics Devices, Streetman, PHI, 5th Edition,(2006)

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

Justification for the mapping

PO1: Disciplinary Knowledge

The concepts covered in CO1 and CO3 contribute to building a strong foundation in the disciplinary knowledge of semiconductor physics and electronics. CO5, CO6 and CO7

Contribute to expand the disciplinary knowledge to cover communication and electromagnetic theory. Antennas are fundamental components in communication systems, and understanding their characteristics and radiation patterns is crucial in this disciplinary context.

PO2: Critical Thinking and Problem Solving

CO1, CO2, CO3, CO4, CO6, and CO7 require students to apply critical thinking skills to understand, analyze, and solve problems related to semiconductor devices, antenna, microwave and their applications.

PO3: Social competence

Co6 and CO7 required to understanding the applications of semiconductor devices could involve considerations of social impact and relevance in various fields.

PO4: Research-related skills and Scientific temper

All Cos contribute the research related skill and scientific temper. CO1 to CO5 involve understanding fundamental concepts that are crucial for any scientific research in the field of semiconductors. CO6 and CO7 required developing system using semiconductor devices and solar cell.

PO5: Trans-disciplinary knowledge

CO1 required for quantum mechanics and CO5 for semiconductor fundamentals provide a trans-disciplinary perspective as they are foundational concepts applicable in various scientific and engineering disciplines.

PO6: Personal and professional competence

CO4, CO6 contribute the knowledge of applications is crucial for students' professional competence as engineers or professionals in the field of electronics. CO7 required for solar related system development

PO8: Environment and Sustainability

CO7 directly relates to the function of a solar cell, which has implications for environmental sustainability.

PO9: Self-directed and Life-long learning

The complex nature of semiconductor physics covered in CO1, CO5, CO6 and CO7 encourages self-directed and life-long learning as students delve into fundamental concepts that require continuous exploration and understanding.

SYLLABUS (CBCS) FOR M.Sc. I. Electronic Science (w.e. from June, 2019)

Academic Year 2019-2020

Class : M. Sc. I (Semester- II)
Paper Code: ELE4205
Paper : II Title of Paper : Practical Course –IV
Credit 4

Group A: Instrumentation -7

Group B: Electromagnetics, Microwave -3

Group C: Activity -2

Note that for Group C: Activity, please refer Section 5) Examination of this document.

Course Objective:

1. To understand the basics operation of transducers.
2. To learn interfacing of transducers and sensors.
3. To understand the counter circuits.
4. To learn antenna parameters.
5. To learn microwave devices and source.
6. To learn RPM measurement techniques.
7. To study various instrumentation amplifier for sensor interfacing.

Course Outcomes:

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

CO1. Learn the different types, working principle of active and passive transducers.
CO2. Experiment analog electronic circuits using different sensors and Transducers.
CO3. Evaluate different electronic circuits and review the analog and digital circuits.
CO4. Develop ability to design, build and test analog/digital application circuits.
CO5. To know operation of different instruments and antenna elements.
CO6. Ability to study antenna parameters and radiation pattern
CO7. To know operation of microwave test bench application

[A] Practical based on Instrumentation and Measurement System

1. Design build and test rms to dc converter for voltage measurement of ac signal
2. Displacement measurement using LVDT, signal conditioning and DPM
3. Temperature measurement using PT100, signal conditioning and DPM
4. Temperature measurement using thermocouple with cold junction compensation
5. Design build and test IR transmitter and receiver (TSOP1738 or similar) for object detection
6. To build and test current telemetry (4 to 20mA)
7. Ultrasonic transmitter and receiver, distance measurement
8. Pressure measurement using strain gauge
9. RPM measurement using various methods

10. Design light intensity meter using photodiode or LDR and the necessary signal conditioning and display.
11. Use of strain gauge to measure stress on a cantilever made of material known quantity
12. Hot wire anemometer

[B] Practical based on Electromagnetics, Microwaves, Antennas

1. To study the characteristics of Klystron tube
2. To determine the standing wave ratio and reflection coefficient of a given waveguide
3. To measure an unknown impedance with smith chart
4. To determine the frequency and wavelength in rectangular waveguide
5. To study the characteristics of directional coupler
6. Design and test Yagi-Uda antenna with power reflectors
7. Measurement of primary-secondary coupling factor of a given transformer using LCR meter (calculation of transformer model parameters expected)

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

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Students will able to demonstrate working and use of transducer, which helpful for development of application.

CO2: Students will able to develop analog design for sensor and transducer for dedicated application. This is a strong relation.

CO3,4: Students will able to design and implement effective interfacing circuits for different types of transducers using analog or digital circuits.

CO5: Students will develop knowledge to demonstrate the various instruments performance, use and antenna working.

CO6: Students will demonstrate the use of test bench and microwave application.

CO7: Students will be able to develop capability develop hardware and discussion result.

PO2: Critical Thinking and Problem Solving

CO1: Students will apply their knowledge for selecting transducer for specific application.

CO2: Students will think to develop specific analog design using sensor and transducer for dedicated application.

CO3: Student will think to develop system for observing the problem.

CO4: Students will use their knowledge for solving complex analog and digital hardware design.

CO5: Students will apply their knowledge for use of instruments for diverse application with reduced error.

CO6: Students will use their understanding to use of microwave frequency, microwave test bench for various applications.

CO7: Students will increase thinking ability to develop experimental skill to design electronics system for diverse field problem solving.

PO3: Social competence

CO1: Students will able to write idea or communicate the use of sensors and transducers for industrial, agriculture, medical, automobile or any other relevant application.

CO2: Student will apply the idea to exhibit the hardware design for required field.

CO3,4: Student will use their knowledge for design analog, digital or combination circuit for dedicated application to solve real-world problems.

PO4: Research-related skills and Scientific temper

CO1,2,3,4: Student develop their ability to think need of sensor and transducers and design necessary circuit.

CO5: Students will able to use scientific instruments for result analysis and standardisation.

CO6,7: Students apply their knowledge for antenna design.

PO5: Trans-disciplinary knowledge

CO2,34: Student will use their knowledge for designing electronic system for solving practical problems interdisciplinary field.

CO7: Required to use microwave test bench for semiconductor material characterization in interdisciplinary field such as physics.

PO6: Personal and professional competence

CO3,4: 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.

PO8: Environment and Sustainability

CO3,4,5: Student will think to develop system for environmental parameter monitoring system which help various applications, energy conservation using sensor and transducers.

PO9: Self-directed and Life-long learning

CO3,4,5,6: Student will think the technical solution for real-world problems and start-up in electronics design for various application. It is lifelong learning due to technology up gradation.

SYLLABUS (CBCS) FOR M.Sc. I. Electronic Science (w.e. from June, 2019)

Academic Year 2019-2020

Class : M. Sc. I (Semester- II)
Paper Code: ELE4206
Paper : II Title of Paper : Practical Course –V
Credit 4

Course Objectives:

1. To understand the basics of embedded C programming.
2. To learn communication standards and protocols.
3. To understand the interfacing of PIC microcontroller.
4. To learn real interfacing devices to PIC microcontroller.
5. To understand the interfacing of AVR microcontroller.
6. To learn real interfacing devices to AVR microcontroller.
7. To learn directivity pattern of antenna.

Course Outcomes:

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

CO1. Understand specifications of PIC and AVR microcontroller.
CO2. Understand architecture of PIC and AVR microcontroller.
CO3. Learn the skills for programming the PIC microcontroller.
CO4. Interface different devices to PIC microcontroller.
CO5. Study serial communication interface with PIC .
CO6. Interface different devices to AVR microcontroller.
CO7. Learn the skills for programming the AVR microcontroller.

GroupA: AVR Microcontroller 5/6
Group B: PIC Microcontroller 5/6
Group C: Activity 2
Note that for Group C: Activity please refer section 5) Examination of this document.

[A] Practical on AVR Interfacing (5/6)
1. Interfacing of LED array to generate different sequences, use of timer for delay generation
2. LCD / keyboard Interfacing
3. DAC interfacing (sine, staircase, triangular, square wave) use of timer
4. Use of ADC
5. DC motor control using PWM / Intensity control of LED – with CCP
6. Serial EEPROM / EEPROM interface using SPI protocol
7. Real time clock (RTC)
8. Stepper motor Interfacing

9. Dot matrix rolling display
10. Two digit frequency counter or event counter using timer /interrupt
11. Servo motor interfacing

[B] Practical on PIC Interfacing (5/6)
1. Two-digit 7-segment display(multiplexed) interfacing
2. LCD / keyboard Interfacing
3. Bidirectional stepper motor interfacing
4. Real Time Clock display on LCD / HyperTerminal(I2C)
5. Use of internal EEPROM
6. DAC interfacing (square wave, staircase, triangular, sine) use of timer for
7. Use of ADC
8. Two digit frequency counter or event counter using timer /interrupt
9. Matrix keyboard / Touch screen
10. Graphic LCD interfacing
11. Zigbee communication
12. DC motor control using PWM / intensity control of LED

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

Justification for the mapping

PO1 :Disciplinary Knowledge

CO1,CO2,CO3: Providing a strong foundation in microcontroller systems and programming within the domain of electrical and computer engineering.
CO4,CO5: Delving into the practical application of microcontroller concepts, connecting theoretical understanding with hands-on skills in interfacing and communication.
CO6,CO7: Immersing students in the practical aspects of microcontroller applications, reinforcing their understanding of embedded systems and control.

PO2: Critical Thinking and Problem solving

CO1,CO2,CO3: Developing the analytical ability to design and implement solutions in the embedded systems domain.

CO4,CO5: Students to solve problems related to device integration and communication protocols, fostering a problem-solving mindset.
CO6,CO7: Encouraging students to analyze and solve problems related to device integration and control system development.

PO3 :Social competence:

CO1,CO2,CO3: Enabling students to collaborate in interdisciplinary projects, fostering teamwork and effective communication in a professional setting.
CO4,CO5: Encouraging collaboration in projects involving diverse devices, facilitating effective communication and cooperation among team members.
CO6,CO7: Preparing students to work collaboratively in projects involving diverse technologies, promoting effective communication and teamwork.

PO4 : Research-related skills and Scientific temper

CO1,CO2,CO3: Fostering an analytical and inquisitive mindset necessary for exploring advanced microcontroller applications.
CO4,CO5: Encouraging students to investigate and understand the intricacies of device integration and communication protocols in a systematic and scientific manner.
CO6,CO7: Promoting a methodical approach to problem-solving and fostering an inclination towards systematic experimentation in microcontroller applications.

PO5: Trans-disciplinary knowledge

CO1,CO2,CO3: Providing a foundation for students to apply their skills across various engineering domains requiring microcontroller applications.
CO4,CO5: Preparing students to apply their skills in diverse contexts involving the integration of various devices and communication protocols.
CO6,CO7: Equipping students to apply their knowledge in different domains, where microcontrollers play a crucial role in system integration.

PO6: Personal and professional competence:

CO1,CO2,CO3: Providing students with a strong foundation in microcontroller technology, essential for their professional growth.
CO4,CO5: Equipping students with practical skills in integrating devices and implementing communication interfaces, essential for their professional development.
CO6,CO7: Preparing students to apply their knowledge in real-world scenarios, fostering their professional growth and adaptability.

PO7: Effective Citizenship and Ethics

CO1,CO2,CO3: Instilling a sense of responsibility in using technology ethically and contributing responsibly to society through informed technological decisions.
CO4,CO5: Encouraging students to consider the ethical implications of integrating devices and implementing communication interfaces, promoting responsible and socially aware engineering practices.
CO6,CO7: Preparing students to use their knowledge responsibly, considering ethical aspects in the application of microcontroller technology for the betterment of society.

PO8 Environment and Sustainability:

CO1,CO2, CO3: Enabling students to develop energy-efficient and environmentally friendly microcontroller applications, contributing to sustainable technology solutions.
CO4, CO5: Promoting efficient device integration and communication, reducing energy consumption and environmental impact in microcontroller-based systems.
CO6, CO7: Enabling students to create energy-efficient and sustainable solutions using microcontroller technology.

PO9 Self-directed and Life-long learning:

CO1,CO2,CO3: Equipping students with the ability to adapt to evolving technologies and continuously update their skills throughout their professional journey.
CO4,CO5: Encouraging students to explore and master new concepts independently, fostering a mindset of continuous learning and adaptation.
CO6,CO7: Instilling the capability to independently acquire new skills, adapt to emerging technologies, and pursue lifelong professional development.