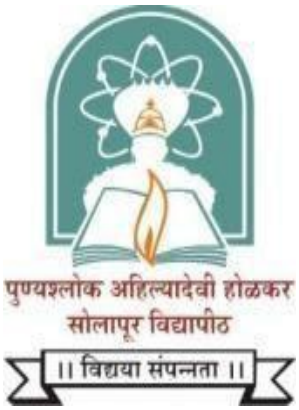
# Punyashlok Ahilyadevi Holkar Solapur University, Solapur




**NAAC Accredited-2022**
**'B$^{++}$'Grade (CGPA2.96)**

# Name of the Faculty: Science &Technology

(As per New Education Policy 2020)

# Syllabus: Electronic Science

## Name of the Course: M.Sc. I (Sem. I & II)

**(Syllabus to be implemented from June 2024)**

# Punyashlok Ahilyadevi Holkar Solapur University, Solapur
## Faculty of Science & Technology
## Nep 2020 Compliant Curriculum
## MSc (Electronic Science)
## Program Preamble

The Master of Science (MSc) in Electronic Science is a comprehensive and dynamic program designed to provide students with a deep understanding of the fundamental principles of Entrepreneurship, along with the practical skills required to apply this knowledge in various scientific and technological contexts. Aligned with the vision of the National Education Policy (NEP) 2020, the program offers a flexible, multidisciplinary, and learner-centric curriculum that encourages critical thinking, innovation, and holistic development. The MSc Electronic Science program spans two years, with each year offering a progressively advanced curriculum designed to build a strong foundation in Electronic Science while allowing for specialization and interdisciplinary learning. The curriculum is structured around several key components:

1. **Discipline Specific Core Courses:** These core courses form the backbone of the program, providing in-depth knowledge and understanding of essential Electronic Science concepts, theories, and methodologies. Students will engage with topics from Internet of Things, Advance Embedded System, Advance Embedded System, PLC and SCADA, Integrated Circuits and VLSI etc. ensuring a robust and comprehensive education in the multidisciplinary approach.

2. **Discipline Specific Elective Courses:** The program encourages intellectual exploration beyond the core discipline by offering a wide range of elective courses. These electives enable students to pursue their interests in diverse subjects, fostering creativity, critical thinking, and a well-rounded educational experience.

3. **Field Projects /Internships /Apprenticeships /Community Engagement Projects /On-Job Training:** To bridge the gap between theoretical knowledge and real-world applications, the program includes opportunities for field projects, internships, apprenticeships, and community engagement. These experiences provide students with practical insights, problem-solving abilities, and exposure to professional environments, enhancing their readiness for careers in Electronic Science and related fields.

4. **Research Methodology and Research Projects:** Research is a critical component of the MSc Electronic Science program, with students acquiring skills in research methodology, data collection, analysis, and scientific inquiry. By engaging in independent research projects, students are encouraged to develop innovative solutions to complex scientific problems, preparing them for advanced studies and research-oriented careers.

***Multiple Entry and Multiple Exit Options***

In accordance with the NEP 2020, the MSc Pharmaceutical Chemistry program incorporates a Multiple Entry and Multiple Exit framework, offering students the flexibility to enter or exit the program at various stages. This approach ensures that students can tailor their educational journey according to their personal and professional goals, with options to earn certificates, diplomas, or degrees based on the duration of study completed.

- **Year 1**
  Upon completion of the first year, students may exit with a **Diploma in Electronic Science**

- **Year 2**
  Upon Completion of the two-year, student may exit with a **MSc Degree in Electronic Science .**

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**
**Faculty of Science & Technology**
**Nep 2020 Compliant Curriculum**

## MSc (Electronics Science)

## Program Outcomes (PO)

**Students Post graduating from the Master of Science in Electronic Science program will be able to:**

**Major Courses:**

- **PO1**: Demonstrate in-depth knowledge and understanding of core concepts, theories, and methodologies in the chosen major discipline.
- **PO2**: Apply disciplinary knowledge to solve complex problems, analyze data, and make informed decisions in professional and research contexts.

**Electives Courses:**

- **PO3**: Explore diverse subjects beyond the core discipline, fostering a broad-based education and cultivating critical thinking and creativity.

**Field Projects/Internship/Apprenticeship/Community Engagement Projects/ On Job Training/ Internship/Apprenticeship:**

- **PO4**: Apply theoretical knowledge to real-world situations through field projects, internships, community engagement and On job Training for gaining practical experience and problem-solving skills.

**Research Methodology and Research Project:**

- **PO5**: Acquire research skills, including data collection, analysis, and interpretation, fostering a scientific approach to problem-solving to develop independent research projects handling capabilities.
- **PO6:** To develop the ability to present Electronic Science research by means of an oral presentation, a scientific poster or a written report.

## General Structure of the Course:

| Level/ Difficulty | Sem. | Paper Code | Title of the Paper | Semester exam | | | L | T | P | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Mandatory** | **Theory** | **IA** | **Total** | | | | |
| | | **DSC-1** 2320101 | Electronic System Design | 60 | 40 | 100 | 4 | -- | - | 4 |
| | | **DSC-2** 2320102 | Microcontroller & Interfacing | 60 | 40 | 100 | 4 | | - | 4 |
| | | | **Elective (Anyone)** | | | | | | | |
| | **III** | **DSE-1 A** 2320107 | Signals & systems | 60 | 40 | 100 | 4 | | - | 4 |
| | | **DSE-1 B** 2320108 | Digital Electronics & Verilog HDL | 60 | 40 | 100 | 4 | | - | |
| **6.5/400** | | **DSE-1 C** 2320109 | Network Analysis & Synthesis | 60 | 40 | 100 | 4 | | - | |
| | | | | | | | | | | |
| | | **RM** 2320103 | Research Methodology | 60 | 40 | 100 | 4 | - | 0 | 4 |
| | | | **Practical** | | | | | | | |
| | | **DSC-1 P** 2320104 | Electronic System Design | 30 | 20 | 50 | - | - | 2 | 6 |
| | | **DSC-2 P** 2320105 | Microcontroller & Interfacing | 30 | 20 | 50 | - | - | 2 | |
| | | | **Elective (Any one)** | | | | | | | |
| | | **DSE-1A P** 2320106 | Practical-II (Based on DSE-1A) | 30 | 20 | 50 | | | 2 | |
| | | **DSE-1B P** 2320106 | Practical-II (Based on DSE-1B) | 30 | 20 | 50 | | | 2 | |
| | | **DSE-1C P** 2320106 | Practical-II (Based on DSE-1C) | 30 | 20 | 50 | | | 2 | |
| | | | **Total for II semester** | **330** | **220** | **550** | **16** | **550** | **6** | **22** |
| | | | **Mandatory** | | | | | | | |
| | | **DSC-3** 2320201 | Control System | 60 | 40 | 100 | 4 | | - | 4 |
| | | **DSC-4** 2320202 | Mechatronics | 60 | 40 | 100 | 4 | -- | - | 4 |
| | **IV** | | **Elective (Any one)** | | | | | | | |
| | | **DSE-2A** 2320207 | Digital Signal Processing | 60 | 40 | 100 | 4 | | - | 4 |
| | | **DSE-2B** 2320208 | Advanced Microcontrollers and Protocols | 60 | 40 | 100 | 4 | | - | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **DSE-2C** 2320209 | Advanced Power Electronics | 60 | 40 | 100 | 4 | | - | |
| | | | **Field Project/RP/Internship/Apprenticeship/** | | | | | | | |
| | | **OJT** 2320203 | On Job Training: Internship/Apprenticeship | 60 | 40 | 100 | 4 | - | 0 | 4 |
| | | | **Practical** | | | | | | | |
| | | **DSC-3 P** 2320204 | Practical-I | 30 | 20 | 50 | - | - | 2 | 6 |
| | | **DSC-4 P** 2320205 | Practical-II | 30 | 20 | 50 | - | | 2 | |
| | | | | | | | | | | |
| | | | **Elective (Any one)** | | | | | | | |
| | | **DSE-2A P** 2320206 | Practical-II (Based on DSE-2A) | 30 | 20 | 50 | | | 2 | |
| | | **DSE-2B P** 2320206 | Practical-II (Based on DSE-2B) | 30 | 20 | 50 | | | 2 | |
| | | **DSE-2B P** 2320206 | Practical-II (Based on DSE-2C) | 30 | 20 | 50 | | | 2 | |
| | | | **Total for II semester** | **330** | **220** | **550** | **18** | **550** | **6** | **24** |

DSC- Discipline Specific Course, DSE- Discipline Elective course
RM- Research Methodology, OJT- On Job Training
RP – Research Project
L – Lecture, T – Tutorial, P – Practical Credits of Theory = 4 Hours of teaching per week
2 Credits of Theory = 4 Hours per week

पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ
।। विद्यया संपन्नता ।।
NAAC Accredited-2022
'B++' Grade (CGPA-2.96)

# Punyashlok Ahilyadevi Holkar Solapur University, Solapur
## Faculty of Science & Technology
## Nep 2020 Compliant Curriculum
## MSc (Electronics Science)
## Program Specific Outcomes (PSOs)

**Students post graduating from the Master of Science in Electronics Science will able to:**

- **PSO 1:** Understand the basics of different subjects in Electronics Science
- **PSO 2:** Display the knowledge of appropriate theory, practices and tools for the specification,design, implementation
- **PSO 3** Ability to formulate, model, design solutions, procedures and use software tools to solve real-world problems and evaluate.
- **PSO 4:** Develop the ability to present Electronics Science research by means of an oral presentation, a scientific poster or a written report.

# Semester – I

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ ।। विद्यया संपन्नता ।। NAAC Accredited-2022 'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-I**<br>**Vertical: DSC**<br>**Course Code: 2320101**<br>**Course Name: Electronic System Design** |
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble: Fundamentals of Circuit Design**: Understanding the basics of analog and digital circuits and their integration. . Sensors & Transducers: Study of devices that convert physical quantities into measurable signals (temperature, pressure, etc.). Data Acquisition Systems (DAQ): Techniques for capturing, measuring, and digitizing real-world signals for processing. Measurement Systems: Design of systems for precise measurements, including error analysis, calibration, and signal integrity. Automation & Control: The integration of feedback systems for industrial automation and process control. Miniaturization: Reducing the size of systems while maintaining performance. Power Efficiency: Designing low-power systems, especially for portable and IoT applications. Real-time Processing: Ensuring that systems can process data in real time, which is critical for control systems. Integration of Analog and Digital Components: Balancing the precision of analog measurements with the flexibility of digital processing.

| | |
|---|---|
| | **Course Objectives:** |
| • | To know the Understanding Fundamental Concepts |
| • | To understand Signal Conditioning and Processing |
| • | To get knowledge Data Acquisition and Processing |
| • | To get skill of Problem-Solving and Innovation |
| | **Course Outcomes:** |
| CO1: | Proficiency in Electronic System Design: |
| CO2: | Application of Theoretical Knowledge: |
| CO3: | Mastery of Signal Processing Techniques |
| CO4: | Problem-solving and Analytical Skills: |
| **Unit 1:** | **Introduction:** **[15]**<br>**Weightage: 15M** |
| | Units and standards of measurement, functional elements of Measurement system, static and dynamic characteristics or performance characteristics of transducer,Measurement and calibration systems- Requirement.<br>Working principle of Resistance type, Capacitance type, inductive, and displacement transducer.Working principle of level transducers, pressure transducers and flow |

| | |
|---|---|
| | transducers.<br>Working principle of Thermometers, Resistance temperature detector (RTD), Thermistors, Thermocouples, and Pyrometers. pH measurement, Conductivity measurement, ORP (Oxidation reduction Potential) Measurement, Humidity measurement and Intelligent Sensors. |
| | |
| **Unit 2:** | **Unit 2:** **[15]**<br>**Weightage: 15M** |
| | Zener series and shunt regulators, transistors as series and shunt regulators, regulator design with discrete components and IC 741/78xx, current sources and their design with discrete components and ICs, SMPS design.Design of multivibrators, (AMV, MMV) using ICs (555, 741), schimitt trigger, triangular waveform generator, design of oscillators using 741 |
| | |
| **Unit 3:** | **Unit 3:** **[15]**<br>**Weightage: 15M** |
| | CMOS-TTL and TTL-CMOS interfaces, design of counter using FF and counter ICs, Oscillator design using Schmitt trigger (7414), inverter and NAND gate, MMV using gates and ICs (74/54121, 74221), design of binary to gray code converter, design of full adder using MUX, design of 16-1 using 4 4-1 MUXs, design of parity checker. |
| | |
| **Unit 4:** | **Unit 4 :** **[15]**<br>**Weightage: 15M** |
| | Need for signal conditioning, Current and Voltage standards.<br>**Signal conditioning for Resistive sensors:** RTD, Thermister, load cell, potentiometricsensors.<br>**Signal conditioning for capacitive sensors:** Level sensor, displacement sensor, proximity detector, humidity sensor, differential pressure cell.<br>**Signal conditioning for inductive sensors:** Displacement transducer (LVDT/RVDT), Design of capacitance and inductance meter, design of DVM using 7107, design of frequency synthesizer, design of digital multimeter. |
| | **Reference books:** |
| | E. O. Doebelin, ―Measurement System Application and Design‖,McGraw-hill International, 5th Edition, 2007.<br>. D. Patranabis, ―Principles of Industrial Instrumentation‖, Tata McGraw-Hill, 3rd Edition, 2010.<br>. R.K.Jain, ―Mechanical and Industrial Measurement‖, KhannaPublications, 9th print 2013.<br>. C. D. Johnson, ―Process Control Instrumentation Technology‖, Prentice-Hall of India, 8th Edition, 2009.<br>. Sawhney A. K., "A Course in Electrical And Electronics Measurementsand Instrumentation", Dhanpat Rai & Sons, 11th Edition, 2005.<br>. D. V. S. Murthy, ―Transducers and Instrumentation‖, Prentice-Hall ofIndia, 2nd Edition, 2010. |

| | |
|---|---|
| | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-I**<br>**Vertical: DSC**<br>**Course Code: 2320102**<br>**Course Name: Microcontroller and Interfacing** |
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** The **Microcontroller & Interfacing** course introduces students to the architecture, programming, and practical applications of microcontrollers, which form the backbone of many modern embedded systems. Microcontrollers are integral components in various devices, ranging from household appliances and consumer electronics to industrial automation, automotive systems, and medical devices. This course aims to provide students with a solid foundation in microcontroller fundamentals, including hardware architecture, instruction sets, programming techniques, and peripheral interfacing. It emphasizes the use of microcontrollers in real-world applications, where they control processes, monitor conditions, and perform essential computations in embedded systems.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understanding Microcontroller Fundamentals |
| • | Microcontroller Programming |
| • | Peripheral Interfacing |
| • | Embedded Communication |
| | **Course Outcomes:** |
| CO1: | Proficiency in Microcontroller Architecture and Operation**:** |
| CO2: | Microcontroller Programming Skills**:** |
| CO3: | Peripheral Interfacing Expertise**:** |
| CO4: | Hands-on Experience with Development Tools**:** |
| **Unit 1:** | **Introduction PIC16F877A** **[15]**<br>**Weightage: 15M** |
| | Salient Features of PIC16F877A, Internal architecture, Oscillator and clock, Reset Options, Special function registers, Introduction to Instruction set, Input/output pins, Ports, Counters, Timers, Capture-Compare Modules, On chip UART, On-chip ADCs configuration. |
| | |
| **Unit 2:** | **Introduction AVR32 Microcontroller** **[18]**<br>**Weightage: 15M** |
| | Introduction, Architecture, Features, Pin configuration, General purpose Register, Memory Organization, Status register (SREG), Stack Pointer, Program Counter, Timers (timer block diagram), Interrupts, PWM, Output Compare Mode, Fast PWM Mode, CTC Mode, Analog Comparator, Instruction set. |
| **Unit 3:** | **Software Development Tools for PIC and AVR** **[12]**<br>**Weightage: 15M** |

| | |
|---|---|
| | Introduction to MPLab-X IDE and ATMEL Studio IDE, Components of IDE, Structure of assembly language, Brief description to Editor, Debugger, Assembler, Simulator, |
| | |
| **Unit 4:** | **Programming and Interfacing PIC16F877A [15]**<br>**Weightage: 15M** |
| | Push-Button, LCD, LED's, Relay, 7-Segment, DC-motor, Servo-Motor, Matrix Keyboard, Opto-coupler, (Embedded C Programming expected)<br>LM35, Thermister, Thermocouple (with AD595), LDR, Humidity (HY-HS220), Current sensor, Tachogenerator (Embedded C Programming expected) |
| | **Reference books:** |
| | **Reference Books:**<br>1. Design with PIC microcontroller By J B Peatman, Pearson education<br>2. Intel Handbook on 8 Bit and 16 bit embedded controllers<br>3. PIC microchip Midrange MCU family reference manual.<br>4. Microcontrollers theory and Applications"-By Ajay Deshmukh-TATA McGraw Hill<br>5. https://ww1.microchip.com/downloads/en/devicedoc/39582b.pdf<br>6. https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf |

| | |
|---|---|
| | |
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** The **Signal & Systems** course provides students with a deep understanding of how signals are represented, analyzed, and manipulated, as well as how systems process these signals in both continuous-time and discrete-time domains. It forms the backbone for many advanced topics in electrical and electronics engineering, such as communication systems, control theory, and digital signal processing This course explores mathematical tools and methods used to analyze signals, such as Fourier series, Fourier transform, Laplace transform, and z-transform. It also covers different types of systems, including linear time-invariant (LTI) systems, and their behavior in response to different input signals. Students will study both time-domain and frequency-domain approaches to analyzing signals and systems, gaining a comprehensive view of their relationships and applications.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understanding Signal Representation |
| • | To know about System Analysis |
| • | To know about Time-Domain Analysis & Frequency-Domain Analysis |
| • | To know about Transform Techniques & Convolution and Impulse Response |
| | **Course Outcomes:** |
| CO1: | Proficiency in Signal Classification and Representation**:** |
| CO2: | Understanding of System Properties |
| CO3: | Time-Domain Analysis Skills & Frequency-Domain Analysis Skills |
| CO4: | Mastery of Transform Techniques |
| **Unit 1:** | **Introduction** **[15]**<br>**Weightage: 15M** |
| | **Introduction:** Signal, system, importance of signals and system, continuous time and discrete time signals, transformation of the independent variable, exponential and sinusoidal signals, unit impulse and unit step functions, continuous time and discrete time system, basic system properties and classification of continues and discrete time signals, Mathematical operations on continues and discrete time signals (Scaling, folding, time shifting, addition, multiplication, differentiation and integration, even and odd signals ) |
| | |

| | |
|---|---|
| **Unit 2:** | **nit 2:** **[15]**<br>**Weightage: 15M** |
| | Introduction, region of convergence, properties and thermos of Laplace transform, poles and zeros of rational function s, inverse Laplace, analysis of LTI continuoustime system using Laplace transform. |
| | |
| **Unit 3:** | **Laplace transform :** **[15]**<br>**Weightage: 15M** |
| | Refractive index profile, cut-off wavelength, Numerical aperture, fiber diameter and field measurements. Receiver performance considerations: Noise, Receiver structures, FET preamplifiers, High performance amplifiers. |
| | |
| **Unit 4:** | **Fourier series and Fourier Transform of discrete time signals:** **[15]**<br>**Weightage: 15M** |
| | introduction, Fourier series ofdiscrete time signals, , Fourier transform of discrete time signals, properties of discrete timeFourier transform, discrete timeFourier transform of periodic discrete time signals , analysis of LTI discrete time signal using discrete timeFourier transform. |
| | |
| | **Reference books:** |
| | References:<br>Signals and Systems by Alan V. Oppenhem, PHI<br>Signals and Systems by A NagoorKani, Tata McGraw Hill |

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>।। विद्यया संपन्नता ।।<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-I**<br>**Vertical: DSE (3B)**<br>**Course Code: 2320108**<br>**Course Name: Digital Electronics and Verilog HDL** |
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** This course emphasizes the theoretical concepts of digital logic, including number systems, logic gates, combinational and sequential circuits, and state machines. Students will learn how to design and analyze digital systems using various techniques and tools, including Karnaugh maps and Boolean algebra. A key focus of the course is the use of **Verilog HDL (Hardware Description Language)**, a powerful tool for modeling and simulating digital systems. Students will gain hands-on experience in writing, synthesizing, and simulating Verilog code to create functional digital designs. The course covers both structural and behavioral modeling techniques, allowing students to develop a robust understanding of how to describe complex digital systems effectively. Through a combination of theoretical instruction and practical laboratory work, students will be equipped with the skills necessary to design, test, and implement digital circuits and systems using Verilog. This knowledge is essential for careers in **embedded systems**, **VLSI design**, **digital system design**, and **computer architecture**.

| | |
|---|---|
| | **Course Objectives:** |
| • | To know the Understanding Digital Logic Fundamentals**:** |
| • | To Design and Analysis of Combinational Circuits & Design and Analysis of Sequential Circuits |
| • | To get knowledge about Introduction to Verilog HDL**:** |
| • | To know the Modeling Digital Systems with Verilog**:** |
| | **Course Outcomes:** |
| CO1: | The student knows the Proficiency in Digital Logic Fundamentals**:** |
| CO2: | The student is able to understand Design and Analysis of Combinational Circuits**:** |
| CO3: | The student is able to understand Proficiency in Verilog HDL**:** |
| CO4: | Able to know the Simulation and Verification Skills**:** |
| **Unit 1:** | **Combinational and Sequential Logic Designs: [15]**<br>**Weightage:15M** |
| | Combinational Logic Designs: Multiplexer, Demultiplexer, Encoder, Decoder, Arithmetic and Logic circuits, adder- Half adder, Full adder, carry look ahead adder, n-bit adder, BCD adder, Full subs tractor, binary multiplication and division, floating and fixed-point arithmetic, Comparison circuits, comparator, 4 - bit comparator, parity generator/checker, ALU design (Design of all is expected).<br>Sequential Logic Designs: Design of ripple counter, ring counter, synchronous counter, |

| | |
|---|---|
| | Johnson's counter. Up - down counter, Shift registers, bi – directed shift register, Universal Shift resister. |
| **Unit 2:** | **Synchronous Sequence Machines: [15]**<br>**Weightage: 15M** |
| | State diagram, State reduction, State assignment, implementation using flip flop. Finites state machines, Control Unit design. |
| **Unit 3:** | **PLD's and Architecture of commercial devices: [15]**<br>**Weightage: 15M** |
| | Detail architecture, study of PROM, Simple PLD, PAL, PLA, Digital System design using PLD's, CPLD, FPGA, Xilinx XC95xx CPLDs. |
| **Unit 4:** | **Verilog Programming and model for combinational and sequential logic: [15]**<br>**Weightage: 15M** |
| | Introduction to Verilog HDL, Lexical Conventions, Ports and Modules, Operators, Gate Level Modeling, SystemTasks & Compiler Directives, Test Bench, Data Flow Modeling, Behavioral level Modeling, Tasks & Functions.<br>**Verilog model for combination Logic:** Verilog Programming Examples-basic gates, 4 – bitbinary adder, Multiplexer, Comparator, encoders, decoders.<br>**Verilog Model for Sequential Logic:** Flip – Flops, Latches, counters, Shift Register, StateMachine. |
| | **Reference books:** |
| | 1. Fundamentals of Digital logic Design with Verilog HDL – Brown, Vranesic – SiE ($2^{nd}$edition).<br>2.Verilog HDL: A Guide to Digital Design and Synthesis, Samir Palnitkar, Prentice Hall, SecondEdition, 2003. |

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>।। विद्यया संपन्नता ।।<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-I**<br>**Vertical: DSE (3C)**<br>**Course Code: 2320109**<br>**Course Name: Network Analysis and Synthesis** |

| | |
|---|---|
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** Network analysis deals with determining the electrical properties of circuits, such as voltage, current, power, and impedance, using mathematical and graphical tools. It involves techniques such as nodal and mesh analysis, transient and steady-state analysis, and the use of network theorems like Thevenin's and Norton's theorems. These methods form the basis for understanding how electrical components such as resistors, capacitors, inductors, and others interact in complex circuits. On the other hand, network synthesis involves designing circuits that fulfill specified performance criteria. This includes creating networks that exhibit desired impedance, frequency response, and stability characteristics. Students will be introduced to the principles of filter design, impedance matching, and passive network synthesis techniques like Foster and Cauer forms.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understand Fundamental Concepts |
| • | Analyze Electrical Circuits: |
| • | To get Examine Transient and Steady-State Responses: |
| • | To know the Apply Theoretical Knowledge in Practical Scenarios |
| | **Course Outcomes:** |
| CO1: | Apply Circuit Theorems and Techniques: |
| CO2: | Analyze Transient and Steady-State Responses: |
| CO3: | Understand Network Stability and Performance: |
| CO4: | Solve Real-World Engineering Problems: |
| **Unit 1:** | **Introduction:** **[15]**<br>**Weightage: 15M** |
| | **Kirchhoff's laws:** Node voltage analysis and mesh voltage analysis, network solutions using first order differential equation, initial conditions in networks .**Analysis of networks using Laplace transformation:** Basic theorems of Laplace transformation ,examples of solutions of networks using Laplace transformation. Transforms of signal waveform : the shifted unit step function, the ramp and impulse functions. Waveform synthesis, the initial and final value theorems, convolution integral, convolution as summation. |

| | |
|---|---|
| | **Impedance functions and network theorems:** Concept of complex frequency, transform impedance and transform circuits, series and parallel combinations of elements, superposition and reciprocity, Thevenin's, Norton's, maximum power transfer and Tellegen's theorem. |
| **Unit 2:** | **Two–port parameters:** **[15]**<br>**Weightage: 20M** |
| | Analysis of Networks using Laplace transformation,Relationship of two-port variable, the open circuit impedance parameters, short- circuit admittance parameters, transmission parameters, inverse transmission parameters, the hybrid parameters, inverse hybrid parameters, relationships between parameter sets, series, parallel and cascade connection of two-port networks. |
| **Unit 3:** | **Resonance:** **[15]**<br>**Weightage: 20M** |
| | **Resonance:** Series resonance, impedance and phase angle of series resonant circuit, voltage and current in series resonant circuit. Effect of resistance on frequency response curve, bandwidth, selectivity and quality factor. Significance of Quality factor. Parallel resonant circuit(Tank circuit), resonant frequency, variation of impedance with frequency, reactance curves, numerical problems based on above. |
| **Unit 4:** | **Network synthesis:** **[15]**<br>**Weightage: 15M** |
| | Introduction, scaling network functions, positive real functions, Hurwitz polynomials, driving point synthesis with LC elements, elementary synthesis operations, synthesis of dissipative networks- 2 terminal RC and RL networks (Foster and Cauer forms), properties of RL and RC network functions. |
| | **Reference books:** |
| | 1. Network Analysis: Van Valkenburg, PHI, 2003<br>2. Network Analysis and Synthesis: Bakshi A V, Bakshi U A, Technical Publications, 2009.<br>3. Electric circuits: Joseph Edminister, Schaum's series-McGraw Hill.<br>4. Network analysis and synthesis: Franklin F Kuo, John Wiley and sons, 2nd edition.<br>5. Networks and systems: Roy Choudhury D, New Age International, 2004. |

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>।। विद्यया संपन्नता ।।<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-I**<br>**Vertical: RM**<br>**Course Code: 2320103**<br>**Course Name: Research Methodology** |

| | |
|---|---|
| ***Teaching Scheme**<br>**Project work: 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** Research Methodology is a foundational course aimed at developing students' understanding of the systematic processes involved in conducting research. It is designed to provide the knowledge, tools, and skills required to investigate real-world problems, generate data, and derive meaningful conclusions based on scientific inquiry. This course introduces students to various research paradigms, methods of inquiry, and approaches to data collection and analysis. Emphasis is placed on the development of critical thinking skills and the ability to evaluate and apply research methods effectively. Students will learn to design research projects, formulate research questions, and adopt appropriate methodologies while adhering to ethical standards in research

| | |
|---|---|
| | **Course Objectives:** |
| ● | To understand the Foundations of Research |
| ● | To Develop Research Design Skills |
| ● | To Master Data Collection Techniques |
| ● | To Enhance Data Analysis and Interpretation Skills |
| | **Course Outcomes:** Students can able to understand - |
| CO1: | Demonstrate a Comprehensive Understanding of Research Concepts |
| CO2: | Design a Coherent Research Study |
| CO3: | Apply Data Collection Methods Effectively |
| CO4: | Write and Present Research Findings Effectively |
| **Unit 1:** | **Introduction to Research:** **[15]**<br>**Weightage: 15M** |
| | Scientific Research- Meaning and importance of Research – Types of Research, Selection and formulation of Research Problem – Research Design Motivation and objectives.Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem.Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web Critical literature review – Identifying gap areas from literature review. |

| | |
|---|---|
| | Research methods vs Methodology- Types of research – Descriptive vs. Analytical, Applied vs Fundamental, Quantitative vs. Qualitative, Conceptual vs Empirical, development of working hypothesis. |
| | |
| **Unit 2:** | **Research Methodology in Electronics (15)**<br>**Weightage: 15M** |
| | Overview of research methodology in Electronics, Scientific problem formulation & solving.Execution of the research, Observation and Collection of data, Data interpretation and analysis, Precision and accuracy, Error analysis, Diagrammatic & graphical presentation of data, sampling methods, tools & software, Data Processing and analysis strategies, data analysis with statistical tools. |
| | |
| **Unit 3:** | **Research Skills (15)**<br>**Weightage: 15M** |
| | Writing research paper and/or thesis, making a presentation, writing a research proposal and patents in science and technology, effective verbal communication field data collection, safety in field. |
| **Unit-4:** | **Case Studies (15)**<br>**Weightage: 15M** |
| | Case study description for identified research |
| | **Reference Books:** |
| | 1. An introduction to Research Methodology; Garg B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002., RBSA Publishers.<br>2. Research Methodology: Methods and Techniques, Kothari C.R., 1990. New Age International.<br>3. Research Methodology; Sinha S.C. and Dhiman, A.K., 2002. Ess Publications. 2 volumes.<br>4. Research Methods: the concise knowledge base; Trochim W.M.K., 2005. Atomic Dog Publishing. 270p.<br>5. Research Methodology; Panneerselvam R., PHI, Learning Pvt. Ltd., New Delhi - 2009<br>6. Research Methodology: Concepts and cases, Chawala D. and N. Sondhi ;Vikas Publishing House Pvt. Ltd.<br>6. Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhyay, A.N. Banerjee, PHI, Publisher |

# Semester II

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>॥ विद्यया संपन्नता ॥<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-IV**<br>**Vertical: DSC**<br>**Course Code: 2320201**<br>**Course Name: Control System** |

| | |
|---|---|
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** Control systems engineering is a multidisciplinary field that plays a crucial role in modern technology and industrial processes. This course is designed to provide a comprehensive introduction to control theory and its applications in the design, analysis, and implementation of systems that maintain desired performance while ensuring stability, accuracy, and efficiency. The course covers fundamental principles such as feedback, stability, and dynamic response, with a focus on modeling physical systems, analyzing system behavior, and designing controllers that achieve optimal performance. Emphasis is placed on the application of mathematical tools like transfer functions, state-space models, and frequency response methods, which are essential for understanding and controlling complex systems.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understand Fundamental Concepts |
| • | Model Dynamic Systems |
| • | Analyze System Behavior |
| • | To Design Controllers |
| | **Course Outcomes:** |
| CO1: | Understand and Apply Control System Fundamentals |
| CO2: | Model Dynamic Systems |
| CO3: | Analyze System Performance |
| CO4: | Design Effective Controllers |
| **Unit 1:** | **Introduction** **[15]**<br>**Weightage: 15M** |
| | Basic Concepts of Control System, Open loop and Closed loop systems, Classifications, effect offeedbacks on Control System performance, Transfer function, modeling and representation of Control system, concept of pole and zero, Linear mathematical physical systems, Electrical analogy, Block reduction techniques, Signal flow graph, Mason's gain formula. |
| | |

| | |
|---|---|
| **Unit 2:** | **Time Domain Analysis and stability [15]**<br>**Weightage: 15M** |
| | Type and Order of Control system, Time Response of first and second order systems to unit stepinput. Steady state errors, Time Domain Specifications of Second Order System, Concept ofStability: absolute, relative and marginal, nature of system response, stability analysis usingHurwitz's criterion, Routh's criterion, Basic properties of Root Loci, construction of Root loci.Angle and magnitude condition for stable systems, concept of inverse root locus and root contour |
| | |
| **Unit 3:** | **Frequency Domain and State Variable Analysis [15]**<br>**Weightage: 15M** |
| | Steady state response of a system to sinusoidal input, Relation between time and frequencyresponse for second order systems, Frequency response specifications, Stability Analysis withBode Plots, Introduction to state space analysis, State space representation for i) ElectricalNetwork ii) nth order differential equation iii) Transfer function, State model from transferfunction using: Direct, parallel, cascade, decomposition methods |
| | |
| **Unit 4:** | **Control system components and controllers (only theoretical treatments) [15]**<br>**Weightage: 15M** |
| | Modeling and transfer function of control system components- Potentiometer, DC and ACServomotors, gear trains, tacho-generators. Design concepts of ON-OFF, P, PI, PD, PIDcontrollers, Compensator Networks-lag and lead. |
| | **Reference books:** |
| | **1.**I.J. Nagrath, M.Gopal "Control Systems Engineering", 5th Edition, New Age InternationalPublication<br>**2.** Ogata Katsuhiko, "Modern Control Engineering", 4th Edition, PHI.<br>**3.** Kuo B.C. Automatic Control System, PHI, New Delhi<br>**4.** Schaum's Series book "Feedback Control Systems"<br>**5.** Les Fenical "Control Systems", 1st Edition, Cengage Learning India.<br>**6.** Norman S. Nise "Control Systems Engineering", 4th edition, Wiley<br>**7.** Samarjeet Ghosh, "Control Systems Theory & Applications", 1st edition, Pearson education.<br>**8.** S.K. Bhattacharya, "Control Systems Engineering", 1st edition, Pearson education Standards‖, Butterworth-Heinemann Publications, 2nd Edition, 2004. |

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>।। विद्यया संपन्नता ।।<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-IV**<br>**Vertical: DSC**<br>**Course Code: 2320202**<br>**Course Name: Mechatronics** |

| | |
|---|---|
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** Mechatronics is an interdisciplinary field that integrates mechanical engineering, electrical engineering, electronics, computer science, and control systems to design and develop intelligent systems and automation. This course provides a holistic understanding of how these various disciplines converge to create smart systems that enhance functionality, performance, and efficiency across industries. In this course, students will explore the fundamentals of sensors, actuators, microcontrollers, and control strategies, and how these components work together to build mechatronic systems. The integration of mechanical systems with embedded electronics and control algorithms plays a vital role in modern technological advancements, ranging from robotics and industrial automation to smart devices and automotive systems.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understand Interdisciplinary Concepts |
| • | Solve Engineering Problems |
| • | To Model and Analyze Systems |
| • | Design Mechatronic Systems |
| • | Solve Engineering Problems |
| | **Course Outcomes:** |
| CO1: | Understand and Apply Mechatronics Principles |
| CO2: | Integrate Systems and Components |
| CO3: | Design and Implement Controllers |
| CO4: | Innovate and Improve Systems |
| CO5: | Prepare for Advanced Study or Industry Roles |
| **Unit 1:** | **Unit 1:** **[15]**<br>**Weightage: 20M** |
| | Introduction to mechatronics, Mechatronic design process, Signal Conditioning, Digital Signals, Digital Logic, Fault diagnosis<br>Mechanical components – Pulley, Gears, Levers, Linkages, Screw, Fasteners. |
| **Unit 2:** | **Unit2 :** **[15]**<br>**Weightage: 20M** |

| | |
|---|---|
| | Automobile- Two/four stroke I C engine, Power cycle, Pneumatic and Hydraulic Actuation Systems, Mechanical Actuation Systems, Electrical Actuation Systems. |
| **Unit 3:** | **Unit 3:** [**15]**<br>**Weightage: 20M** |
| | Single phase, three phase supply Conversion of A.C. to D.C and Vice versa.<br>Various types of motors: A/C motors Single phase, Three phase, Variable frequency drives, D/C motor, BLDC, Stepper motor, servo motor |
| | |
| **Unit 4:** | **Unit 3:** **[15]**<br>**Weightage: 20M** |
| | Sensors – Positional sensor, Pressure sensor, Level sensor, Rotary sensor, Infra red sensor, Measurements. Case studies : Bar code reader, Micro wave oven, Electronic printers, Digital camera, Remote control, Washing machine, Elevator, Robotics- Hydraulic, Electrical. |
| | **Reference books:** |
| | 1. Digital Integrated Circuits: A Design Perspective- Jan M. Rabaey, AnanthaChadrakasan,<br>1. Mechatronics with experiments: Sabri Cetinkunt. Wiley Publications.<br>2. Mechatronics: Bradley, Dawson, Burd and Loader Nelson Thornes<br>3. Industrial Electronics: Thomas Kissel Prentice Hall of India<br>4. Robotic Engineering: R.D. Klafter, T.A. Chmielewski, M.Negin, PHI |

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>।। विद्यया संपन्नता ।।<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-IV**<br>**Vertical: DSE (3A)**<br>**Course Code: 2320207**<br>**Course Name: Digital Signal Processing** |
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** Digital Signal Processing (DSP) is a fundamental and rapidly evolving field that plays a critical role in various engineering disciplines, including telecommunications, audio and video processing, biomedical engineering, and control systems. This course introduces students to the essential concepts, algorithms, and techniques used to process signals in digital form. In this course, students will explore the mathematical tools and theoretical foundations behind DSP, such as discrete-time signals and systems, Fourier transforms, and digital filter design. The course emphasizes both theoretical understanding and practical implementation, enabling students to apply DSP techniques to real-world problems in areas like signal analysis, filtering, compression, and noise reduction.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understand Fundamental Concepts of DSP |
| • | Learn Signal Analysis Techniques |
| • | To Design Digital Filters |
| • | To Understand Sampling and Quantization |
| | **Course Outcomes:** |
| CO1: | Understand DSP Fundamentals |
| CO2: | Analyze Signals in Time and Frequency Domains |
| CO3: | Apply Sampling and Quantization Techniques |
| CO4: | Design and Implement Digital Filters |
| **Unit 1:** | **Discrete Time Signals and Linear Systems** **[15]**<br>**Weightage:15M** |
| | Introduction of DSP system,Advantages, Applications, Discrete time signals classifications and representation, Operations on signals, Discrete time system, Classification, Impulse response and convolution sum, Convolution methods, Solution ofDifference equations, Impulse and step responses, Analog to digital conversion: Sampling theorem, Aliasing effect, Quantization, Reconstruction of analog signal. |
| | |
| **Unit 2:** | **Z-Transform and Analysis of Discrete Time System** **[15]**<br>**Weightage: 15M** |

| | |
|---|---|
| | Z-transform and ROC, Z-transform of Finite and Infinite sequences, Properties of Z-transform, Inverse Z transform, System Function of LTI system, Inverse Z-transform, Transient and Steady state responses, Causality and Stability of System, Solution of difference Equations, Realization of Discrete time system by Direct form-I and Direct form-II, Cascade and parallel forms. |
| | |
| **Unit 3:** | **Z-Transform and Analysis of Discrete Time System** **[15]** **Weightage: 15M** |
| | te Fourier Transform, IDFT, Properties of the DFT, Circular shift of sequence, Circular convolution, Circular convolution methods, Linear convolution from circularconvolution, DFT of long duration sequence by overlap-save and overlap-add methods,FFT Algorithms: Radix-2 DIT and DIF algorithms to compute DFT and IDFT. |
| | |
| **Unit 4:** | **Design and Realization of Digital Filters**: **[15]** **Weightage: 15M** |
| | Introduction to Machine learning, Scikitlean, Cat boost, H2O, XG Boost, light gbm, imbalanced-learn, Anaconda and Jupyter notebook, Types and Structure of data. Kaggle database. (Only introduction, features and applications) |
| | |
| | **Reference books:** |
| | 1. John G Prokis, Manolakis, "Digital Signal Processing-Principles, Algorithms and Application",4th Edition, Pearson Education Publication<br>2. Salivahanam, AVallavaraj, C. Guanapriya, "Digital Signal Processing", 1st Edition, TataMcGrawHill, New Dehli<br>3.P.RameshBabu, "Digital Signal Processing", 4th Edition, Scitech Publication.<br>4. P. Pirsch,"Architectures for Digital Signal Processing" John Wiley publication, New Delhi<br>5. B.Venkataramani, M. Bhaskar, "Digital Signal Processors", Architecture programming &applications, TMH, New Dehli |

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>।। विद्यया संपन्नता ।।<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-IV**<br>**Vertical: DSE**<br>**Course Code: 2320208**<br>**Course Name: Advanced Microcontrollers and Protocols** |
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** The rapid advancement of embedded systems has made microcontrollers a critical component of modern technology, driving innovation in industries such as automotive, robotics, IoT, and consumer electronics. This course focuses on advanced concepts in microcontroller architecture and interfacing, with an emphasis on the ARM (Advanced RISC Machine) family of processors, which have become the industry standard for high-performance embedded systems. Throughout the course, students will gain in-depth knowledge of ARM microcontroller architecture, including its core features, instruction set, and peripheral interfacing capabilities. In addition to understanding hardware, the course covers embedded software development, real-time operating systems, and peripheral programming, providing hands-on experience with ARM-based development platforms. The focus will be on practical applications, enabling students to design, develop, and troubleshoot complex embedded systems.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understand ARM Microcontroller Architecture |
| • | Develop Embedded Software |
| • | Explore Peripheral Interfacing |
| • | Apply Advanced Programming Techniques |
| | **Course Outcomes:** |
| CO1: | Comprehend ARM Architecture |
| CO2: | Develop Embedded Software |
| CO3: | Design Complex Embedded Systems |
| CO4: | Interface Peripherals |
| **Unit 1:** | **Introduction to ARM** **[15]**<br>**Weightage: 15M** |
| | Introduction to RISC/ARM, ARM 7 Core, Processor Functional Block Diagram Programmers Model: Data Types, Processor modes, Registers, General Purpose Registers, Program Status Register. |
| | |
| **Unit 2:** | **Instruction Sets of ARM** **[15]**<br>**Weightage: 15M** |
| | ARM instruction set, Thumb Instruction set, Processor core vs Processor, Processor vs Microcontroller, Cortex-M0-M3, Memory and memory mapped I/O, Pipeline, |

| | |
|---|---|
| | Exceptions, Interrupts and Vector table. |
| | |
| **Unit 3:** | **Interfacing in ARM** **[15]**<br>**Weightage: 15M** |
| | Installation of: ST-link driver, OpenST32, Cube-MX,Keil-5 pack, Project creation in Kiel for Leds, Switch, Relay, Access level programs(Embedded C program expected). |
| | |
| **Unit 4:** | **Advanced Embedded Communication Protocols** **[15]**<br>**Weightage: 15M** |
| | Introduction to **I2C**, General I2C Operation, Start, Stop Conditions, Data Validity, Byte Format,ACK, NACK, I2C Data, writing to a Slave on The I2C Bus, Reading from a Slave on The I2CBus. **SPI** terminology, SPI pins, SPI Registers, Clocking modes. The CAN standards, ExtendedCan, bit fields of CAN, CAN Message, CAN Bus. |
| | |
| | **Reference books:** |
| | 1. John Morton, "AVR: An Introductory Course", Newnes.<br>2. Claus Kuhnel, "AVR RISC Microcontroller Handbook", Newnes.<br>3. Steve Furber , "ARM System –On –Chip architecture", Addision Wesley.<br>4. David Seal "ARM Architecture Reference Manual", Addison Wesley, England; MorganKaufmann Publishers<br>5. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide -Designing and Optimizing System Software", Elsevier<br>6. Understanding of I2C Bus, Application Report, TI.<br>7. Keystone Architecture SPI, User Guide, TI.<br>8. Introduction to Control Area Network (CAN), Application Report, TI. |

| | |
|---|---|
| पुण्यश्लोक अहिल्यादेवी होळकर सोलापूर विद्यापीठ<br>।। विद्यया संपन्नता ।।<br>NAAC Accredited-2022<br>'B++' Grade (CGPA-2.96) | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-IV**<br>**Vertical: DSE**<br>**Course Code: 2320209**<br>**Course Name: Advanced Power Electronics** |
| ***Teaching Scheme**<br>**Lectures: 04 Hours/week, 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** Power electronics is a vital field of electrical engineering that focuses on the conversion, control, and conditioning of electric power using solid-state electronics. As global energy demands continue to rise and the push for sustainable energy solutions intensifies, advanced power electronics technologies play a crucial role in enhancing energy efficiency, enabling renewable energy integration, and driving innovations in electric vehicles and smart grids. This course delves into the advanced concepts and techniques of power electronics, exploring the design, analysis, and control of power converters and associated systems. Students will study various converter topologies, including DC-DC, DC-AC, and AC-AC converters, as well as advanced control strategies and modulation techniques. The course also emphasizes the importance of thermal management, electromagnetic interference (EMI) considerations, and reliability in power electronic systems.

| | |
|---|---|
| | **Course Objectives:** |
| • | Understand Advanced Converter Topologies |
| • | Analyze Converter Performance**:** |
| • | Implement Control Strategies |
| • | Foster Innovation in Power Systems |
| | **Course Outcomes:** |
| CO1: | Comprehend Advanced Power Converter Topologies |
| CO2: | Analyze and Evaluate Converter Performance |
| CO3: | Implement Control Strategies |
| CO4: | Implement Practical Applications |
| **Unit 1:** | **Power semiconductor devices:** **[15]**<br>**Weightage: 15M** |
| | Power Diode, Power Transistor (Switching characteristics) and its Base Drive Applications, Power MOSET (Switching characteristics), IGBT, Thyristors, SCR and GTO, MOS-controlled Thyristors.<br>**Thyristors protection:** Over voltage and over current protections, dv/dt and di/dt protections and design of snubber circuits. |
| | |
| **Unit 2:** | **Power Supplies** **[15]**<br>**Weightage: 15M** |

| | |
|---|---|
| | Linear Series Voltage Regulator, Linear Shunt Voltage Regulator, Current Limiting and Overload Protection, Integrated Circuit Voltage Regulators, Fixed Positive and Negative Linear Voltage Regulators, Adjustable Positive and Negative Linear Voltage Regulators, Applications of Linear IC Voltage Regulators, Switching Regulators, Single-ended Isolated Flyback Regulators, Control Circuits and Pulse-width Modulation, Uninterruptible Power Supplies, SMPS, comparison with conventional power supply |
| | |
| **Unit 3:** | **Controlled Rectifiers and Inverters [15]**<br>**Weightage: 15M** |
| | **Rectifiers:** Single-phase Half-wave Rectifier, Single-phase Full wave Rectifier, Power Factor of the Rectifier, Three-phase Half-wave Rectifier, Three-phase Full-wave, power factor improvement<br>**Inverters:** Principles of operation, Performance parameters, Single-phase Voltage Source Inverters, Half-bridge Voltage Source Inverters, Full-bridge Voltage Source Inverters, Introduction, current source invertors, Variable DC link inverter. |
| | |
| **Unit 4:** | **DC–DC Converters: [15]**<br>**Weightage: 15M** |
| | DC Choppers, Principles of step-down and step-up choppers with R and R-L loads, impulse commutated chopper, Step-down (Buck) Converter, Step-up (Boost) Converter, Buck–Boost Converter, Cuk Converter. |
| | |
| | **Reference books:** |
| | 1. Power Electronics by M.H. Rashid, PHI<br>2. Power Electronics – P.C.Sen<br>3. Power Electronics – Williams ELBS<br>4. Simplified design of linear Power supplies: John D. Lenk, Butterworth-Heinemann<br>5. Simplified design of switching power supplies: John D. Lenk, Butterworth-Heinemann<br>6. Regulated power supplies Irving M Gottlieb, TAB books<br>7. Practical Design of Power Supplies: Ron Lenk, IEEE press +McGraw hill<br>8. Electric Power Transformer Engineering: James H. Harlow, CRC Press |

| | |
|---|---|
| | **Punyashlok Ahilyadevi Holkar Solapur University, Solapur**<br>**Second Year M.Sc. (Electronics Science) Sem-IV**<br>**Vertical: RP**<br>**Course Code: 2320203**<br>**Course Name: On Job Training: Internship/Apprenticeship** |
| ***Teaching Scheme**<br>**Project work: 04 Credits** | ***Examination Scheme**<br>**UA: 60 Marks**<br>**CA: 40 Marks** |

**Course Preamble:** On-Job Training (OJT) is a vital component of professional education, providing students with the opportunity to apply theoretical knowledge in real-world settings while gaining valuable industry experience. This course is designed to bridge the gap between academic learning and practical application, enabling students to develop essential skills, competencies, and professional behaviors that are critical in today's dynamic work environment. Throughout this course, students will engage in hands-on training within a professional setting, collaborating with industry professionals and participating in projects that reflect the current challenges and practices of the field. The OJT experience will encompass various aspects of the profession, allowing students to understand workplace dynamics, improve their technical abilities, and enhance their problem-solving and communication skills.

| | |
|---|---|
| | **Course Objectives:** |
| • | Apply Theoretical Knowledge |
| • | Gain Practical Experience |
| • | Develop Professional Skills |
| • | Understand Workplace Dynamics |
| | **Course Outcomes:** Students can able to understand the – |
| CO1: | Apply Knowledge in Real-World Contexts |
| CO2: | Exhibit Practical Skills |
| CO3: | Demonstrate Professionalism |
| CO4: | Solve Industry-Related Problems |

| | |
|---|---|
| • | • **Set Clear Goals**:<br><br>  • Define specific objectives for the OJT period, including what skills and experiences you want to gain.<br>  • Discuss these goals with your supervisor to align expectations.<br><br>• **Be Proactive**:<br><br>  • Take initiative in seeking out tasks and responsibilities. Don't wait for assignments; ask how you can contribute.<br>  • Volunteer for projects or tasks that interest you and align with your career goals.<br><br>• **Communicate Effectively**:<br><br>  • Maintain open communication with your supervisors and colleagues. Ask questions if you're unsure about something.<br>  • Provide regular updates on your progress and seek feedback to improve your work.<br><br>• **Observe and Learn**:<br><br>  • Pay attention to the work environment, processes, and the behavior of experienced professionals.<br>  • Learn from both successes and mistakes; reflect on what works and what doesn't.<br><br>• **Document Your Work**:<br><br>  • Keep a detailed log of tasks you perform, skills you acquire, and insights you gain.<br>  • This documentation will be valuable for your final report and for reflecting on your experience.<br><br>• **Collaborate with Team Members**:<br><br>  • Work collaboratively with colleagues; learn to function effectively as part of a team.<br>  • Share your ideas and be receptive to the input of others.<br><br>• **Seek Feedback and Apply It**:<br><br>  • Regularly ask for feedback from supervisors and peers to understand your strengths and areas for improvement.<br>  • Implement feedback to enhance your skills and work performance.<br><br>• **Maintain Professionalism**:<br><br>  • Dress appropriately for the workplace and adhere to the organization's policies and procedures.<br>  • Demonstrate punctuality, reliability, and a strong work ethic. |

| | |
|---|---|
| | • **Reflect on Your Experience**:<br><br>  • Take time to reflect on your daily experiences and learning outcomes.<br>  • Identify what you enjoyed, what challenged you, and how the experience relates to your academic studies.<br><br>• **Network**:<br><br>  • Build professional relationships with colleagues and supervisors. Attend meetings and participate in discussions to increase your visibility and connect with others in your field.<br>  • Exchange contact information for potential future networking opportunities.<br><br>• **Prepare for Transition**:<br><br>  • As your OJT period concludes, start preparing for the transition to your next academic or professional step.<br>  • Seek guidance on how to leverage your OJT experience in your resume and job interviews.<br><br>• **Submit a Comprehensive Report**:<br><br>  • At the end of the OJT, prepare a detailed report that includes a summary of your tasks, skills gained, challenges faced, and reflections on the overall experience. |

**Nature of Examination:**
Each semester will have theory external assessment examination of 60 marks each (2.5 hrs. duration) and 40 marks college assessment. The practical examination of Semesters I to II will be conducted at the end of each semester. Duly certified copy of laboratory record must be produced at the time of examination.

**Practical Examination of M. Sc. I**
The practical examination will be of 2 days for each semester.

**Semester I:**

| | |
|---|---|
| Practical courses each | : 30 (UA) + 20 (CA) |
| RM | : 60 (UA) + 40 (CA) |

**Semester II:**

| | |
|---|---|
| Practical courses each | : 30 (UA) + 20 (CA) |
| On Job Training | : 60 (UA) + 40 (CA) |

** The evaluation of Research Project will be done by both external and internal examiners at the time of examination.

## Nature of question paper (M. Sc. I):

Time: 2 ½ hours Maximum Marks: 60

***Instructions***

1. All questions are compulsory
2. All questions carry equal marks.
3. Figures to the right indicate full marks.
4. Use of log tables and calculators is allowed.

Question Paper

**Q 1. A) Choose correct alternative** **Marks 8 (1 x 8)**

Sub-questions (i) to (viii)

**B) Fill in the blanks** **Marks 4 (1 x 4)**

Sub questions (i) to (iv)

**Q 2. Answer the following (any six)** **Marks 12 (2 x 6)**

Sub-questions (a) to (h)

**Q 3. Answer the following (any three)** **Marks 12 (3 x 4)**

Sub-questions (a) to (d)

**Q 4. Answer the following (any two)** **Marks 12 (6 x 2)**

Sub-questions (a) to (c)

**Q 5. Answer the following (any two)** **Marks 12 (6 x 2)**

Sub-questions (a) to (c)

**********