Solapur University, Solapur

Syllabus

of

M.Phil. in Electronics

Course Structure :

There shall be 3 papers of 100 marks each. Paper –I and II are compulsory However, Paper –III is Elective. Student has to select one paper from the list of Elective papers. The titles of the theory papers for M. Phil. in Electronics are as under.

- Paper –I   : Research Methodology and Signals and systems

- Paper-II   : Recent Trends in Electronics Research

- Paper-III   (Elective) :

    1. Embedded System Design and RTOS

    2. Fundamentals of Mixed-Signal System Design

    3. Electronic materials Research

Paper –I Research Methodology and Signals and systems

Unit 1: Introduction to the Research Methodology:
Meaning of Research, Objectives, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Selecting the Problem, Defining the Problem, Research Design, Meaning and Need for Research Design

Unit 2: Methods of Data Collection:
Collection of Data, Methods of data collections, Observation, Interview, Questionnaires, Experimental methods of data collection,

Unit 3: Data analysis:
Data analysis, Types of Analysis, Statistics in Research, Least squares fitting procedure, straight line fitting, polynomial fitting, refinement of the data, refinement (R) factor , minimization of the refinement factor, Calibration of the data in Engineering Units.

Unit 4:Interpretation and Report Writing:
Meaning of Interpretation, Technique of Interpretation, Significance of Report Writing, Different Steps in Writing Report, Writing abstracts, Layout of the Research Papers, Writing research papers, Writing review articles, Types of Reports, Oral Presentation, format of writing citations, Fundamental of Citation index and Impact factor.

Unit 5: Signals and Systems:
Introduction, definitions of signals and systems, types of signals and systems, Mechanical systems, Fluid systems, discrete time domain systems, Examples on signals and systems.

Unit 6: Continuous and discrete time signals:
Functions and functional notations, continuous time function, complex, exponential sinusoids, discontinuities, Functions and combination of the functions, Discrete time functions, signal functions, scaling and shifting, periodic function, signal energy and power.

Reference Books:
1. Research Methodology: Methods and Techniques , C R Kothari, Second Edition New Age International, 2004 .
2. Research methodology methods and statistical techniques, Santhosh Gupta, Deep and Deep Publications, New Delhi 2000.
3. Fundamentals of Signals and Systems – Michael J Roberts MGH, New Delhi, 2009.
4. Signals and Systems – H. P. HSU – MGH, New Delhi, 2008.

Paper –II : Recent Trends in Electronic Research

Unit 1:Embedded System Design

Embedded system design, advanced microcontrollers, Architecture of PIC 16F877A microcontroller, overview of memory organization, IO Ports, ADC, DAC, serial communication and Timers etc Architecture of AVR ATmega 8L microcontroller, overview memory organization, IO Ports, ADC, DAC, serial communication and Timers etc. Real Time Operation Systems

Unit 2: Wireless sensor Networks

Introduction to Sensor Networks, Sensor Network Management, A Taxonomy   of Routing Techniques in Wireless Networks, Sensor Network   Architecture, Tiered Architectures in Sensor Networks, Zigbee The RF models**,** Introduction to the RF Modules, ISM band, Specifications of WSN devices, Architecture of the Zigbee module, On-chip resources of the Zigbee Pro, Programming the Zigbee, Designing of WSN with Zigbee modules.

Unit:3 VLSI Design :

The Characteristics of Digital Electronic Design and Representation issues, Design abstraction , Hierarchy Views, Connectivity, Spatial Dimensionality, Design Environments, Design flow, Schematic Entry, HDL, Synthesis, Verification, Implementation, Design Hand-off, Y- diagram, Simulation, Synthesis, Physical level, RTL level, Floor Planning, VLSI Devices: CPLD, and FPGA, Architecture of Programmable Logic Devices- CPLD, FPGA and SOC,.

Unit:4   Mixed Signal SoC Design :

Design Issues of Mixed Signal VLSI, Performance analysis of Analog function blocks (Op-amp, comparator) Basics of ADC & DAC, SoC design Methodology, SoC peripheral cores, interconnect, synthesis of peripheral cores, System/Block level software & hardware verifications, Architecture of PSoC, Digital & Analog PSoC blocks, Memory/register organization, IO ports, clock, interrupt, Dynamic reconfigurations Cores,General block diagrams of Actel ProASIC 3 and cypress PSoC.

Reference Books:

1. Transducer Interfacing Handbook- A guide to analog signal conditioning- Daniel H Sheingold, Analog Devices, Massachusetts
2. PIC Microcontroller and Embedded Systems using Assembly ad C for PIC 18 M. A. Mazidi , R. D. Mckinlay and D. Causey Pearson Education, NewDelhi (2009)
3. datasheet of AVR ATmega 8L Atmel corporation
4. Product data sheet of LPC 2378.
5. Ad Hoc Wireless Networks: Architecture and Protocols, C. Siva Ram Murthy, B.S. Manoj, Pear. edu.
6. Computer Aids for VLSI Design, Second Edition, Steven M. Rubin
7. Modern VLSI Design: SOC design by Wayone wolf
8. Designers Guide to the Cypress PSoC by Robert Ashby Elsevier
9. Introduction to mixed signal Embedded design – Van Ess, Curie and Daboli Cypress lab Manual.

Paper - III (Elective –I)-Revised
Embedded System Design and RTOS

Unit 1: Advanced Microcontroller based Embedded system design (12)

Advanced Microcontroller based embedded system: Minimum requirement of Hardware and software for ARM Microcontroller. Clock circuit, Reset circuit, In system programming (ISP), Designing of ARM microcontroller based embedded systems for Measurement of pH, Humidity, wind velocity, temperature etc

Unit 2: Fundamentals of Real Time Operating System (10)

a) **Introduction:** Concept of Real Time, Real Time operating System, Characteristics of Real-Time operation system, Hard and Soft Real Time Systems.
b) **Structure of RTOS:** Structure of RTOS, RTOS Kernel, Kernel Objects, Services of Scheduler.
c) **Task :** Task, Task structure, Creation of task, types of task, Task Control block, context, States of task and FSM, idle task, Priority, Static and dynamic priority, Resources, Sharing of resources, ISR, Task Management.

Unit 3 Scheduling Algorithm : (7)

Task scheduling Algorithm, preemption, FIFO, Round Robin scheduling, priority based preemptive scheduling. Priority Inversion, Software and hardware time Ticks, context switching. Simple programs based on Tiny RTOS kernel.

Unit:4 Task Synchronization (11)

a) **Synchronization of task :** Concept of Sharing of resources, Race condition, Critical condition, deadlocks, spinlocks,
b) **Semaphores and mutexes :** Concept of semaphore, Binary semaphore, Counting semaphore, Semaphore management, **Mutexes :** Concept of mutex, mutex management.
c) **Intertask communication:** Intertask Communication, Messages, Queues, Mailboxes.

Unit:5 Instrumentation design (10)

Development of instrumentation for
- Agricultural applications
- Measurement of Industrial applications

Reference Books:

1. Embedded C - Michael J Pont
2. Go Embedded – Yashawant Kanetkar BPB.
3. Embedded C Programming and the Atmel AVR - R. H. Barnett, S. Cox and L. O'Cull
4. Embedded C Programming and the Microchip PIC - R. H. Barnett, S. Cox and L. O'Cull
5. *Operating Systems – A.S. Godbole*
6. Real-Time Systems – C.M. Krishna and K.G. Shin

Paper - III (Elective –II) -Revised
Fundamentals of Mixed-Signal System Design

Unit-1 Mixed-signal embedded SoC architectures. **(12)**

Mixed-signal SoC architectures. Microcontroller ARM Cortex-7 core. Instruction set. RAM and flash memory system. I/Os. System buses. Interrupt subsystem. Interrupt Service Routine (ISR).

Unit-2 Programmable Digital subsystem. **(12)**

Performance improvement through architecture customization. PSoC programmable digital building blocks (timers, counters, clocks, PWM). Static and Dynamic reconfiguration.

Unit-3. Programmable Communication block. **(10)**

Data communication in embedded systems. Serial communication using SPI and UART.

Unit-4.Continuous time and Switched-capacitor analog building blocks. (4)

Continuous time analog blocks, PGA, Instrumentation amplifier, Comparator, Concept of reference voltage levels. Basics of switched capacitor analog circuits. Presentation of basic building blocks, i.e., ideal op amps, comparators, gain stages, integrators, etc. Application of Switch-Capacitor circuits.

Unit-5. Analog and digital Filter design blocks. **(6)**

Filter fundamentals, Filter parameters Filter design issues, Analog filters design, Digital filter design, use of switched capacitor for analog filter design. FIR filter

Unit-6. Analog to digital converters. **(10)**

Nyquist Theorem, Basics of Delta-Sigma converters (DS). Sampling. Quantization. Oversampling. Noise shaping. Performance of DS ADC. First-order DS ADC. Second-order DS ADC. Implementation using PSoC. Impact of circuit nonidealities on ADC performance.

Reference Books:
1. Introduction to Mixed signal, Embedded Design A. N. Doboli and E. H Currie Cypress semiconductor corporation (2007)
2. Designers Guide to the Cypress PSoC by Robert Ashby Elsevier
3. CMOS Circuit design, Layout and Simulation, R. J. Baker, WSE, Willey (2009)

Paper - III (Elective –III)
Electronic materials Research

1. **Electric Polarization And Relaxation**

   Fundamental Concepts, Motion of Electrical Charge Carriers, Electromechanical Effects, Electrostatic Induction, Electric Polarization and Relaxation in Static Fields, Mechanism of Polarization, Classification of Dielectric Materials, Nonferroelectric Materials, Ferroelectric Materials, Internal Field, Electric Polarization and Relaxation in time varying fields, Complex Permittivity, Crammers equation, Debye Equation, Effect of dc conductivity, Cole- Cole plots, Relaxation phenomenon.

2. **Introduction to Magnetism**

   Measurement of Field Strength, Hall Effect, Electronic Integrator or Fluxmeter, Magnetic Measurements in Closed Circuits, Demagnetizing Fields, Magnetic Shielding, Demagnetizing Factors, Magnetic Measurements in Open Circuits, Instruments for Measuring Magnetization, Vibrating - Sample Magnetometer, Altering (Field) Gradient Magnetometer - AFGM or AGM, (also called Vibrating Reed Magnetometer), Magnetic Circuits and Parameters, Permanent Magnet Materials, Susceptibility Measurements.

3. **Characterisation Technique.**

   UV-VIS Spectroscopy, IR Spectrometry, X-ray absorption, Fluorescence, and diffraction methods, Energy dispersive X-ray analysis (EDAX), Electron spectroscopy for chemical analysis (ESCA), Optical parameter measurement (n,k), Thickness measurement of microscopic technique: Optical microscope, scanning electron microscope (SEM), Transmision Electron Microscopy, (TEM), Atomic Force Microscopy(AFM), Sacninng tunnelling microscopy

4. **Ferromagnetism & Ferrimagnetism**

   Introduction, Molecular Field Theory, Exchange Forces, Band Theory, Ferromagnetic Alloys, Theories of Ferromagnetism. Introduction, Structure of Cubic Ferrites, Saturation Magnetization, Molecular Field Theory, Above Tc, Below Tc, General Conclusions, Hexagonal Ferrites, Other Ferromagnetic Substances, y - $Fe2O_3$, Garnets, Alloys, Summary : Kinds of Magnetism

Reference Books:

1. Dielectric Phenomena in Solids: Kwan Chi Kao & F. R. de Boer

2. Introduction to Solid State Physics : C. Kittle

3. K. H. J. Buschow & F. R. de Boer: Physics of Magnetism and Magnetic Materials.