Solapur University, Solapur

Course Work

(w.e.f June 2014)

For

M.Phil. in Electronics
and
Ph.D. in Electronics

Solapur University, Solapur
Course Work
For
M.Phil. and Ph.D. in Electronics
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Course Structure :

There shall be 3 papers of 100 marks each. Paper –I is compulsory for all faculties/subject. However, Paper –II and III are of **Electronics** subject. Paper –II is compulsory, whereas paper- III is Elective. Student has to select one paper from the list of Elective papers. The List of elective papers may vary as per variations in the Research areas of Guides and the students. The titles of the papers for Course work for M.Phil. and Ph.D. in Electronics are as under.

- Paper –I : Research Methodology and Information Communication Technology (ICT)
- Paper-II : Recent Advances in Electronics
- Paper-III (Elective) :
    1. Architecture of Wireless Sensor Network
    2. Embedded Technology and Instrumentation
    3. Mixed-Signal PSoC based Embedded design

Paper –II : Recent Advances in Electronics

Unit 1: ARM Microcontroller based System Design

Introduction to ARM microcontroller, ARM Core Philosophy, Bus Architecture, AMBA Bus, AHB, APB, Registers, Current program status register(CPSR), Saved program status register(SPSR), Stack pointer, Link register, Modes of processor , States of the processor, ISA, Pipelining register , TDMI, Interrupts and Exceptions, Interrupt latencies. Nomenclature of ARM families. ARM instruction set architectures, Barrel shifter,

Unit 2: Architecture of LPC 2148 ARM Microcontroller .

Architecture of LPC 2148 Pin Description, On-Chip memory, memory map, GPIO, clock and timing, On chip peripherals , ADC, DAC, DMA controller, UART, Timer /Counter, Real time clock, Watchdog timer, CAN and Ethernet, I2C mode, USB host/slave.

Unit 3: 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 4: Analog CMOS circuit elements

MOS Switch and its characteristics, MOS Resistor, MOS Capacitors, MOS Diode, Current sink and current source circuits, Current mirrors, passive and active current mirrors. References for Analog MOS circuits, Voltage and Current reference, Band gap reference. CMOS operational amplifier.

Unit:5 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. ARM System Developers Guide- A. N. Sloss, D. Symes & C. Wright –Elsevier (2004)
2. Product data sheet of LPC 2148.
3. Wireless Sensor Networks technology, protocols and applications, Kazem Sohraby , Daniel Minoli, Taieb Znati, Wiley, 2013
4. CMOS Analog Circuit Design, P. E. Allen, D. R. Holberg, Indian students edition Oxford, 2013
5. Designers Guide to the Cypress PSoC by Robert Ashby Elsevier
6. Introduction to mixed signal Embedded design – Van Ess, Curie and Daboli Cypress lab Manual.

Paper – III (Elective-I): Architecture of Wireless Sensor Networks

Unit 1. Introduction to Wireless Sensor Networks

Concept of Site Specific Management (SSC), Introduction to Wireless Sensor Networks, Wireless Sensor Network (WSN) Architecture, Salient features of Wireless Networks, Types of WSNs Category –I- and Category –II, Clustered, Layered, Hierarchical, Non-hierarchical, Applications of WSN.

Unit 2. Architecture of Wireless Sensor Node:

Architecture of Sensor Node, Salient feature, General Block diagram. Designing of AVR microcontroller based sensor node. Hardware: Functional block diagram, Interfacing of the sensor, signal conditioning, configuration of ADC, Serial Communication, Interfacing of LCD, Power considerations.

Unit 3. The Zigbee RF models :

Introduction to the RF Modules, ISM band, Specifications of WSN devices, Architecture of RF Module- Zigbee module, Pin Description, block diagram. Comparison between RF module and Bluetooth. Programming of the Zigbee The X-CTU : salient features of X-CTU, Programming steps, Programming the Zigbee.

Unit 4. PROTOCOLS

Overview of Wireless Communication Protocols for Sensor Networks, wireless networking protocols (IEEE 802.11, 802.15), Energy efficient protocols, LEACH, PEGASIS etc.

Unit 5. Case Studies :

Development of Wireless Sensor Network for

- Agricultural applications
- Measurement of Industrial parameters such as temperature, pH etc.
- Domestic applications

REFERENCE BOOKS:

1. Ad Hoc Wireless Networks: Architecture and Protocols, C. Siva Ram Murthy, B.S. Manoj, Pearson education
2. Wireless Sensor Networks technology, protocols and applications, Kazem Sohraby , Daniel Minoli, Taieb Znati, Wiley, 2013
3. Datasheets of RF module Zigbee pro.
4. Wireless Sensor Networks Signal Processing and Communication Perspectives, WILEY Publications by Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong
5. Wireless Sensor Networks: Application-Centric Design Edited by Dr. Geoff V. Merret and Dr. Yen Kheng Tan (Editor-in-Chief)

Paper – III (Elective-II): Embedded Technology and Instrumentation

Unit 1: Embedded system design (Hardware)

Introduction: Concept of embedded system, structure of embedded system, characteristics of embedded system, types of embedded system,

a) **Microcontroller based embedded system:** Minimum requirement. Microcontroller, Clock circuit, Reset circuit, In system programming (ISP)
b) **Embedded system design** : Designing of MCS51 microcontroller based embedded systems for Measurement of pH, Humidity, wind velocity, temperature etc.

Unit 2: Embedded system design (Software)

a) **Introduction** : Need of embedded software, Need of operating system, structure of embedded C program, Superloop, IDE, Development tools, Programming tools, flash magic
b) **Delay :** Generating software Delays, C Delay Loops, Generating Hardware Delays, Example Flash LED Using Timer, with Interrupts.
c) Development of embedded software for MCS51 microcontroller based embedded systems for Measurement of pH, Humidity, wind velocity, temperature etc.

Unit 3: Fundamentals of Real Time Operating System

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,
d) Resources, Sharing of resources, ISR, Task Management.

Unit 4 Scheduling Algorithm :

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:5 Task Synchronization and Intertask communication:

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.

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-III): Mixed-Signal PSOC based Embedded Design

Unit –1 Introduction.

Meaning and need of Mixed signal based VLSI design, Concept of PSoC, Basic of CMOS and BiCMOS transistor, Op-Amp design. Concept of mixed signal design. Design Issues of Mixed Signal VLSI, Mixed-signal SoC ,architectures. Mixed-signal SoC architectures. Microcontroller M8C core. Instruction set. RAM and flash memory system. I/Os. System buses. Interrupt subsystem. Interrupt Service Routine (ISR). Boot program

Unit-2 Programmable Digital subsystem. 8

Architecture of Programmable digital subsystem, PSoC programmable digital building blocks (timers, counters, CRC generator, PWM). Data communication in embedded systems. Serial communication using SPI and UART. Data communication in embedded systems. Serial communication using SPI and UART

Unit-3. Continuous Time analog building blocks. 6

Basics of continuous time analog circuits. Presentation of basic building blocks, i.e., ideal op amps, comparators, PGA, Instrumentation amplifier, integrators, etc.

Unit-4. Switched-capacitor analog building blocks.

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 to digital converters.

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 Alex N Daboli and Edward H Curie
2. Cypress Semiconductor Corporation , USA
3. System-On-A-Chip Verification methodology & Techniques by Prakash Rashinkar, Peter Paterson, Lenna Singh.
4. Designers Guide to the Cypress PSoC by Robert Ashby Elsevier