C-DAC &Gujarat Technological University
M.E. Electronics & Communication Engineering
(VLSI & Embedded Systems Design)
Gandhinagar

Semester – II

2725201: Systems Design

Part – I Embedded Hardware Design

UNIT I: Introduction to Embedded Systems
Definition and Classification – Overview of hardware units in an embedded system – Software embedded into the system – Complex System Design Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits

UNIT II: High speed hardware system design challenges
Transmission line effects, characteristic impedance, radiation, single ended Vs. differential I/O standards and their applications, crosstalk and noise, high speed signal terminations, high speed I/O standards used in interfacing e.g. HSTL, SSTL, HCSL, CML, LVPECL, LVDS etc…, AC/DC coupling, Routing on multilayer PCB, Reference voltage requirements, Compliance to standards like FCC, CE etc…, Power requirement analysis, safety margins, fail safe mechanisms/redundancy, Power supply filtering, Power monitoring, ESD requirements in handling circuit boards, ESD safe environment

UNIT III: Introduction to PCB Fabrication
The importance of interconnects. The basics. History and evolution. Component selection. Bill of materials. Specification and classification of PCBs. Techniques of layout design. Artwork generation methods - manual and CAD. General design factor for digital and analog circuits. Layout and artwork making for SS, DS and ML Boards. Design for manufacturability. A review of specification design standards. Introduction to PCB technology. Anatomy of laminates, resins, reinforcing materials. Photo tool generation including screen preparation. Imaging techniques. PCB Fabrication techniques-single, double sided and multi layers. Drilling operation-manual and CNC.
Etching: chemical principles and mechanisms. Plating operations manual and automated. Post operations-stripping, black oxide coating and solder masking. PCB component assembly processes. Environmental concerns in PCB industry.

UNIT IV: PCB Layout
Embedded Hardware & Firmware Design and Development Analog &Digital Electronic components, VLSI & Integrated circuit design, Electronic Design Automation tools , PCB layout Design and its fabrication .Embedded firmware design approaches , Board design theory and application, multi-layer PCB boards, signal integrity andnoise handling, auto-routing, manufacturing.

UNIT V: Hardware/Software Co-design
Co-design Methodologies; Code Generation for Rapid Prototyping; Board bring up planning, FPGA prototyping, Power Consumption Issues; Applications.

Part – II Embedded Systems Software Design

UNIT I:
Introduction to Embedded Systems, Growth of Embedded Systems, Embedded System Architecture and components including sensors, ADC, DAC, control and status units, communication interfaces, Types of embedded systems, Design constraints, Concept of compilers and debuggers, Need for prototyping, Prototyping using FPGA platforms.

UNIT II:
Introduction to Embedded C, Need for Embedded C, Difference between C and Embedded C, Embedded C fundamentals – data types, functions, pointers, structures.

UNIT III:
Introduction to Keil C and Keil compiler, Simulating embedded applications, configuration settings, build, compile, link, debug, run commands, Interfacing input and output devices.

UNIT IV:
Microcontroller architecture and assembly language programming, Instruction set, types of instructions, branch, call, interrupt service routine, Programming using different types of MCUs.

UNIT V:
Applications of embedded systems – communication systems, automotives, home appliances, security systems, aviation.

Lab:
Tools used during laboratory works: Encore or any other related tool.
- Study of creating package symbols (schematic and layout).
- Study of high speed signal PCB Layout guidelines.
- Selective system design

Tools used during laboratory works: Keil, Cypress PSoC, relevant FPGA or MCU kits.
- Study and implementation of compilers and debuggers.
- Study and implementation of applications on various platforms.

Course Project:
- A project of suitable complexity, comprising of program design, coding, compilation and debug must be completed.
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Reference:

1. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003
2. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes, David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.

3. Wayne Wolf, Computers as Components; Principles of Embedded Computing
4. System Design - Harcourt India, Morgan Kaufman Publishers, First Indian Reprint 2001
5. Frank Vahid and Tony Givargis, Embedded Systems Design - A unified Hardware/Software Introduction, John Wiley, 2002.
6. Product documentation from ARM (KEIL), Cypress, other FPGA/MCU vendors.
7. William Hohl. ARM Assembly Language - Fundamentals and Techniques, CRC Press, Taylor and Francis Group 2009
8. Michael Barr and Anthony Massa. Programming Embedded Systems with C and GNU development Tools, O'Reilly 2007