GUJARAT TECHNOLOGICAL UNIVERSITY

Subject Name: System Design
Subject Code: 3725201

Semester II

Type of course: ME - Electronics & Communication Engineering (VLSI & Embedded Systems Design

Prerequisite: Basic of microprocessor.

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	2#	0	5	70	30	30	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment;

Content:

Sr. No.	Content	Total Hrs	% Weightage
	PART 1: Introduction to Embedded Systems		
1	**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	4	8
2	**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	4	8
3	**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	3	8

	automated. Post operations- stripping, black oxide coating and solder masking. PCB component assembly processes. Environmental concerns in PCB industry		
4	**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 and noise handling, auto-routing, manufacturing	3	8
5	**Hardware/Software Co-design** Co-design Methodologies; Code Generation for Rapid Prototyping; Board bring up planning, FPGA prototyping, Power Consumption Issues; Applications	3	8
	PART 2: Embedded Systems Software Design		
1	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	3	8
2	Introduction to Keil C and Keil compiler, Simulating embedded applications, configuration settings, build, compile, link, debug, run commands, Interfacing input and output devices	3	7
3	Detailed study of ARM Microcontroller architecture and its Instruction set, types of instructions, branch, call, interrupt service routine, Programming using assembly language and C language	3	8
4	Applications of embedded systems – communication systems, automotives, home appliances, security systems, aviation	3	7

Reference Books:

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

Course Outcome:

After learning the course the students should be able to:

- Understand about the basic of embedded system.
- Understand about PCB design layout.
- Understand about Embedded C and Microcontrollers.

List of Experiments: (with Open Ended Problems)

1. Create new schematic library and PCB library using PCB design tool for creating schematic symbol and footprint for PIC18F4550 – TQFP44 and AD0804 – DIP 20.
2. Draw the schematic of data acquisition system to sense temperature using PCB design tool.
   a) Microcontroller: PIC18F4550 – TQFP44
   b) ADC : AD0804
   c) Temperature sensor: LM35
   d) Display : LCD 16x2
   e) Use multiple sheets: (1) Microcontroller, clock circuit, reset circuit and power supply (2) ADC, Temp. sensor, LCD16x2
3. To Design single sided PCB layout of dual power supply for +/-12V.
4. To Design single sided PCB layout of Schmitt trigger based on IC741.
5. To Design single sided PCB layout of 3-bit up/down Counter.
6. To Design double sided PCB layout for simple microcontroller system.
   a) Microcontroller: PIC18F4550 – TQFP44
   b) Clock circuit, Reset Circuit and all port connected to 8 pin headers.

Major Equipments:

1. **Cypress PSoC, relevant FPGA or MCU kits.**

List of Open Source Software/learning website:

1. **Altium**
2. **Keil**

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website