GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: POWER ELECTRONICS (24)
SUBJECT NAME: Embedded Systems for Power Electronics
Subject Code: 2172407
BE SEMESTER VII

Type of Course: Engineering Science (Electronics)
Prerequisite: 2142406 (Digital Electronics &I its Applications)
2152409 (Micro Controller for Power Electronics)
2162412 (Programmable Logic devices & Applications)
Rationale: This subject is aimed at developing concept of hardware of digital signal processors, digital real time operating systems, development tools etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

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

Content:

Sr. No.	Topic With Details	Teaching Hrs.	Module Weightage (%)
1	**Introduction to Digital Signal Processing Systems:** DSP concepts, history, characteristics of DSP systems, Classes of DSP applications, advantages, disadvantages, features DSP processors, Embodiments	4	10
2	**Numerical Representation of Data:** Numerical representations and Arithmetic, Fixed point, fractional binary numbers (Q format), floating point, data word width, extended precision, floating point emulation and block floating point, IEEE 754 floating point, relation between data word size and instruction word size etc.	4	10
3	**Data path, memory architecture and addressing:** Fixed point data path, floating point data path, special function unit, Memory structure, Features for reducing memory access requirements, wait states, ROM, external memory interface, customization Addressing modes, Implied addressing, immediate data, memory direct addressing, register direct and indirect addressing, Short addressing	8	20
4	**Instruction set, execution control and pipelining:** Instruction types, registers, parallel mov support, orthogonality, assembly language support Hardware looping, interrupts, stacks, relative branch support Pipelining , pipelining depth, interlocking, branching effects, interrupt effects, pipelining program models	8	20
5	**On chip Peripherals and other facilities:** Serial ports, timers, parallel ports, Bit I/O ports, Host ports, Communication ports, A/D , D/A, External interrupts, implications for the system designer Scan based debugging /emulation facilities Clocking	8	20

Sr. No.	Topic With Details	Teaching Hrs.	Module Weightage (%)
6	**Development tools:** Assembly language tools, High level language development tools, block diagram based development tools, Software development for embedded systems, RTOS, Multitasking, task scheduling etc.	8	10
7	**TI code composer studio(CCS):** Overview and working with CCS, Its use in implementation of real time systems.	8	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance R Level	**Understanding U Level**	**Application A Level**	**Analyze N Level**	**Evaluate E Level**
30%	**25%**	**25%**	**10%**	**10%**

Legends: R : Remembrance ; U = Understanding; A = Application and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. Embedded System Design A Unified Hardware Software Introduction, Frank Vahid, Tony Givargis, Wiley India
2. The DSP Handbook Algorithms, Applications and design techniques, Andrew Bateman, Iain Paterson-Stephens, Pearson Education
3. DSP Processor Fundamentals Architectures and Features, Phil Lapsley, Jeff Bier, Amit Shoham, IEEE Press.

Course Outcome:

After learning this course, the students should be able to understand following concepts.

1. Importance of embedded systems in implementing real systems.
2. Use of embedded systems in power electronics system
3. Design flow, simulation and design tools used, working with these tools etc.

Laboratory Work:

Objectives: The laboratory work is aimed at putting the theory learnt in class in practice and to show the results are nearly matched with theory. In this context, following are the core objectives for laboratory work of this subject.

- Develop understanding of basics of embedded systems.
- Understand the basics of software design using development tools
- Develop understanding of software design tools.
- Understand the use of CCS.

Directions for Laboratory work:

- ✓ The list of experiments is given as a sample.

- ✓ Minimum 10 experiments should be carried out. Alternatively, around 7 experiment for basic study should be given. Based on basic study, a small digital system modelling exercise can be given. e.g. PWM generator,
- ✓ Similar laboratory work fulfilling the objectives can also be considered.
- ✓ As far as possible printed manual should be preferred so that students can concentrate in laboratory experiments and related study.

The sample list of experiments is given below with reference to VHDL and

List of Practical and Open Ended Problems:

1. Study of embedded system
2. Study of development tool (eg TI CCS)
3. Study of software development tools
4. To prepare a small program using CCS and learn running the same.
5. To read the digital signals from real world.
6. To read analog data from real world
7. To write data to output port
8. To study timer functions
9. To study PWM generation using DSP
10. To interface with Power Electronic System

List of Open Source Software/learning website:

Open Source Software:

Web-based tools for design:

Open source for Math Tools:

- http://maxima.sourceforge.net/
- http://www.sagemath.org/
- http://www.scilab.org/
- http://www.gnu.org/software/octave/

Learning website:

- http://nptel.iitm.ac.in/courses.php
- http://ocw.mit.edu/
- www.ti.com
- http://www.electrical-engineering-portal.com
- http://www.fpga4fun.com/
- http://www.eng.auburn.edu/department/ee/mgc/vhdl.html
- http://allaboutfpga.com/
- http://www.iverilog.com/
- http://www.edaplayground.com/
- http://www.asic-world.com/
- http://www.gmvhdl.com/

Major Equipments:

- Oscilloscope, Logic Analyser, Multimeter, DSP kit etc.

Active learning Assignments (AL) : Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.