GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3162417
Semester VI
Embedded Systems for Power Electronics

Type of course: Professional Elective Course

Prerequisite: Microcontrollers Architecture, Interfacing and Applications

Rationale: Embedded systems is an important field of engineering study in this era of automation. Now a days, almost every home appliance, industry application, electronic gazettes, wearable have one or another programmable device. They all have some hardware and software both. With this background about the embedded systems, it is required to understand embedded systems in context of power electronics applications. We all know that in power electronics applications, real time control of power electronics switches is important to obtain desired output to be fed to load. Control of Power Electronic System is carried out through high end microcontrollers, DSP, DSC, or FPGA based systems. In complex systems, combination of FPGA with DSP/DSC/microcontrollers is also used. The embedded systems when designed properly, may improve system reliability, and make fail safe system. This is very much important in certain critical applications where reliability is of prime importance. For example, a power supply system for critical load like a data server. This course aims to build general understanding about the embedded systems and how it can be used in digitally controlled power electronic systems.

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)	
3	0	2	4	70	30	30	20	150

Contents:

Sr. No	Topics content	Teaching Hours	Module Weightage
1	**Introduction:** Real time embedded systems, definition, characteristics, architecture, examples of embedded systems Embedded system components, structure, processors (microcontrollers, DSPs, general purpose microprocessors), memory, input output devices, role of embedded systems with reference to power electronics applications	4	10%
2	**Embedded Processors and Memory:** Computer architecture, Harvard architecture, Von Neumann architecture, role of memory, types of memory, data storage, memory hierarchy, cache memory and mapping, DRAM types and working. General Purpose Processors, signals involved, multiplexing of signals, Embedded processors, microprocessors vs microcontrollers, microcontroller architecture and on chip peripherals, memory interfacing	8	20%
3	**Embedded System IO:** Interfacing bus protocols, ISA bus etc., timers, interrupts, DMA, USB, IrDA, ADC, DAC, Analog interfacing	7	20%
4	**Design of Embedded Processors:** FPGA concepts and hardware descriptive language basic concepts	4	10%
5	**Embedded Communications:**	4	10%

	Parallel communication, serial communication, network communication, wireless communication		
6	**Embedded System Software:** Real time systems, task scheduling, real time operating systems (RTOS), commercial RTOS	5	10%
7	**Software Engineering Issues:** Concepts of software engineering, Requirements Analysis and Specification, modelling timing constraints, software design	5	10%
8	**Testing of Embedded Software:** Testing embedded systems, design for testability, built in test for embedded systems, boundary scan methods and standards, online testing of embedded systems	5	10%

Reference Books:

1. Frank Vahid, Tony Givargis, "Embedded System Design, A Unified Hardware/Software Introduction", John Wiley and Sons Inc, 2002
2. Andrew Bateman, Iain Paterson-Stephens, "The DSP Handbook Algorithms, Applications and design techniques", Pearson Education
3. Wayne Wolf, "Computers as Components Principles of Embedded Computing System Design", Elsevier

Course Outcome:

Sr. No.	CO statement At the end of this course, students will demonstrate the ability to	Marks % weightage	Topics Mapped
CO1	understand the concept of embedded system, microcontroller, different components of microcontroller and their interactions.	20	1,2
CO2	understand interfacing of embedded system processors with peripherals.	50	2,3,4,5
CO3	understand the concept of real time embedded systems.	10	6
CO4	understand the key concepts of software development for embedded system.	20	7,8

The following are suggested list of experiments based on theme:

1. To study embedded systems.
2. To study processors used for embedded systems.
3. To study memory
4. To study interfacing protocols in embedded systems.
5. To study hardware peripherals for embedded systems
6. To study interfacing of analog system with digital processors
7. To study communication protocols used in embedded systems
8. To study real time operating systems
9. To study software engineering
10. To study testing of embedded software testing

Major Equipment:

PC/Laptop, FPGA Kits, micro controller kits, oscilloscope, Logic analyzer, patch cords etc.

List of Open Source Software/learning website:

1. https://nptel.ac.in/courses/108/105/108105057/
2. https://nptel.ac.in/courses/108/102/108102045/