GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000711

Subject Name: Embedded Systems

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Digital electronics, simple microcontrollers, theoretical concepts of digital signal
Rationale:	In the modern world, every application in our life has become digital. Most of the industrial applications are digitally controlled. In this context, the role of Embedded System has become the most important. Industrial applications need power control where Power Electronics plays a major role. In this context, embedded systems are an inherent part of any power control application. This makes studying of embedded systems important part of curriculum of Power Electronics Engineering.

Course Outcome:

After Completion of the Course, the student will be able to:

No	Course Outcomes
01	Relate application requirements with processor/controller.
02	Describe the embedded system components.
03	Plan hardware and software for given application.
04	Select microcontroller for given application.

Teaching and Examination Scheme:

Teaching Scheme (in Hours/week)			Total Credits (L + T + (PR/2))	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction:** Review of Digital electronics concepts like number system, coding, combinational logic, sequential logic, common digital system building blocks – MUX, DMUX, Encoder, Decoder, etc. Motivation based on applications of embedded systems, Basics of Embedded systems, functional block	6	10
2.	**Modeling of Embedded system:** Mathematical modeling of physical systems to fit into embedded systems, Continuous Dynamics, Discrete	8	20

	Dynamics, Hybrid Systems, actor models, Composition of State Machines		
3.	**Microcontrollers:** Basics of Microcontrollers, MCS51, Arduino microcontroller development board, C2000 family microcontrollers, I/O s, Sensors, Actuators	8	20
4.	**Hardware:** Interfacing between analog and digital blocks, signal conditioning, digital signal processing. sub-system interfacing, interfacing with external systems, user interfacing, PWM generation, interrupts, communication, on chip peripherals etc.	8	20
5.	**Software:** Software aspects of embedded systems: real time programming languages and operating systems for embedded systems. Task, Task scheduling.	8	20
6	**Power Electronics:** Embedded systems in Power Electronic applications case study.	4	10
	Total	**42**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**30**	**30**	**10**	**10**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
4. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.
5. S. Chattopadhyay, Embedded System Design, PHI Learning Pvt. Ltd, 2023, 3rd Edition.
6. Herma K, W. Steiner, Real Time Systems – Design for Distributed Embedded Applications, Springer International Publishing AG, 2022, 3rd Edition.
7. C.M. Krishna, Kang G. Shin, Real Time Systems, McGraw Hill, 2017, 1st Edition.
8. Tim Wiscott, Applied control for embedded systems, Elsevier Publications, 2011,1st Edition.
9. Jim Ledin, Embedded control systems in C/C++, CRC Press, 2003, 1st Edition.
10. Resources available on www.ti.com

(b) Open-source software and website:

1. https://nptel.ac.in/courses/108102045
2. https://nptel.ac.in/courses/108102169

Suggested Course Practical List:

The following list is for suggestions only. The subject teacher can change the list according to availability of resources. The experiments should focus on implementation using software concepts like tasks, task scheduling etc. in topic 5. The latest controller from the selected family should be considered.

1. Study of IDE tools for embedded systems
2. Writing and testing simple programs to understand selected IDE software tools.
3. Reading digital signals at input port.
4. Writing digital signals to output port.
5. Reading analog signal.
6. Interfacing with LCD / 7 Segment display
7. Generating PWM signals
8. Implementing control algorithms.
9. Small project in which concepts of the subject can be implemented.

List of Laboratory/Learning Resources Required:

PC/Laptop with installed IDE, Simulator/ Controller board etc.

Any Other:

1. www.ti.com

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