# GUJARAT TECHNOLOGICAL UNIVERSITY

## BIO MEDICAL ENGINEERING (31)
EMBEDDED SYSTEMS FOR BIOMEDICAL APPLICATIONS
**SUBJECT CODE:** 2723110
SEMESTER: II

**Type of course**: Core Subject

**Prerequisite:** Assembly and C language

**Rationale:** NA

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | | | |
| L | T | P | C | ESE (E) | PA (M) | ESE (V) | | PA (I) | | |
| | | | | | | ESE | OEP | PA | RP | |
| 3 | 2# | 2 | 5 | 70 | 30 | 20 | 10 | 10 | 10 | 150 |

**Content:**

| Sr. No. | Topics | Teaching Hrs. | Module Weightage |
|---|---|---|---|
| 1 | Definition and Classification – Overview of Processors and hardware units in an embedded system – Software embedded into the system – Exemplary Embedded Systems – Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits - Embedded Hardware Architecture, Communication Interface Standards, Embedded System Development Process, Embedded Operating systems, Types of Embedded Operating systems. | 8 | 15 |
| 2 | Intel MCS51 Architecture – Derivatives - Special Function Registers (SFR), I/O pins, ports and circuits, Instruction set, Addressing Modes, Assembly Language Programming, Timer and Counter Programming, Serial Communication, Connection to RS 232, Interrupts Programming, External Memory interfacing , Introduction to 16 bit Microcontroller. Interfacing of 8051 with ADC, sensors, stepper motor, key board, & DAC. | 10 | 22 |
| 3 | PIC Microcontroller - Introduction, CPU architecture, registers, instruction sets addressing modes Loop timing, timers, Interrupts, Interrupt timing, I/o Expansion, I 2C Bus Operation Serial EEPROM, Analog to digital converter, UART-Baud Rate- Data Handling-Initialisation, Special Features - serial Programming-Parallel Slave Port | 10 | 20 |
| 4 | Embedded system evolution trends. Round - Robin, robin with Interrupts, function-One-Scheduling Architecture, Algorithms. Introduction to-assembler-compiler-cross compilers and Intergrated Development Environment (IDE). Object Oriented Interfacing, Recursion, Debugging strategies, Simulators. Task and Task States, tasks and data, semaphores and shared Data Operating system Services-Message queues-Timer Function- Events-Memory Management, Interrupt Routines in an RTOS | 10 | 20 |

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|---|---|---|---|
| | environment, basic design Using RTOS. | | |
| 5 | Applications: Real-Time Embedded Software Development, Sending a Message over a Serial Link, Simulation of a Process Control System, Controlling an Appliance from the RT Linux System, Embedded Database Applications, Embedded medical applications: Ophthalmology - Glaucoma screening device, Medical Imaging Acquisition User Interface, Drug delivery systems, Patient monitoring Systems. | **10** | **23** |

**Reference Books:**

1. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003
2. M A Mazidi & Mazidi, The 8051 micro controllers, Pearson Education
3. Tim Wilmshusrst, Designing Embedded Systems with PIC, Newnes publishing, 2007
4. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes,
5. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.

**Course Outcome:**

After learning the course the students will be able to:
1) Understand the concept of embedded system design and its application in different design and product, Programming for Embedded System Design.
2) Understand architecture and functionalities of each block inside the processor
3) Get idea about working of processor and its application
4) Select appropriate microcontroller for design
5) Calculate memory requirement and other on-chip/off-chip peripheral requirement
6) Understand requirement of a project as well as inputs and outputs of the system
7) Make flowchart of different tasks and decisions
8) Understand multitasking environment and development tools
9) Design software for the target processor/controller
10) Interface peripherals with the board
11) Understand different communication protocols to make the system as a part of network

**List of Experiments:**

1. Introduction to Embedded Systems and various design tools.
2. Interfacing of LED with ARM.
3. Interfacing of Seven Segments with ARM.
4. Interfacing of LCD display with ARM.
5. Interfacing of Stepper Motor with ARM.
6. Interfacing of GSM Module with ARM.
7. Interfacing of RF Tx and Rx with ARM.
8. Introduction to CCS and DSK 6713 kit.
9. Interfacing of Seven Segments with DSK 6713.
10. To Display word "Hello" with CCS and DSK 6713

**Open Ended Problems:**

Apart from above experiments a group of students has to undertake one open ended problem/ design problem. Few examples of the same are given below.

1. Interfacing ARM7 development board to PC via USB port to transfer file.
2. SPI based network design.
3. SCI based network design.
4. CAN network application design
5. I2C network application design
6. Create zigbee RF transmitter receiver link
7. RFID based system design
8. Create touchsceen based application
9. Application to display institute logo on graphics LCD/LCD monitor/LCD TV
10. Developing an RTOS based multitasking applications Major Equipments: MATLAB, DSK 6713, CCS, ARM 7/9 Boards, ARM IDE, Keil and different interfacing Modules etc.

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**List of Open Source Software/learning website:**

1) http://www.freertos.org/
2) http://ecos.sourceware.org/
3) https://www.kernel.org/
4) http://www.coocox.org/index.html
5) https://www.rtai.org/
6) http://www.uclinux.org/
7) http://www.embeddedcraft.org/listrtos.html
8) www.embedded.com
9) www.virtualbreadboard.com
10) www.parallax.com
11) www.arduino.cc

**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