# GUJARAT TECHNOLOGICAL UNIVERSITY

## BIO-MEDICAL ENGINEERING (03)
EMBEDDED SYSTEM DESIGN
**SUBJECT CODE:** 2160307
B.E. 6<sup>th</sup>SEMESTER

**Type of course: Core**

**Prerequisite:** Digital Electronics, Basic Electronics, C Language Programming, Microprocessor & Interfacing, Microcontroller & Applications.

**Rationale:** To familiarize students with concepts of Embedded Systems and give them sufficient knowledge about programming, interfacing, debugging and implementing standalone systems for varied range of Biomedical Applications.

**Teaching and Examination Scheme:**

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

**Content:**

| Sr. No. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction to Embedded Systems:** Defining Embedded Systems, Essential Attributes of Embedded Systems, Exploring PIC16F87X for Embedded Systems, Classifications of Embedded Systems, Examples of Embedded Systems, Introduction IDE like MPLAB, MikroC etc. | 5 | 10% |
| 2 | **PIC Microcontroller (16F87X Series):** PIC Microcontroller, Architecture, Configuration, Peripherals, Serial Interfaces, MPLAB Projects, Program & Debug. | 10 | 20% |
| 3 | **Programming the Embedded Systems in C:** Getting started, C program basics, Data operations, Sequence control, Functions & Structure, Input & Output, More Data types, Compiler directives. | 7 | 12% |
| 4 | **C Peripheral Interfaces:** Analog Inputs, Analog output, Interrupts, Hardware timers, UART Serial link, SPI Serial bus, Parallel & Serial Interfaces. | 10 | 15% |
| 5 | **PIC16F87X based Embedded System  Applications:** LED Interfacing, Switch (DIP) Interfacing, Interfacing Buzzer & switch,  LCD Interfacing, ADC Conversion, Opto-Isolator Interfacing,  Square & Triangular Waveform Generation Using PIC, Displaying Data on Hyper Terminal, Hyper Terminal Interface & Control: Getting Sensor Signal on Hyper Terminal, Controlling an Actuator such as Relay from PC Hyper Terminal. | 16 | 28% |
| 6 | **Introduction to Arduino UNO board & Applications:** Overview, Features, Board diagram, Programming Arduino board.<br>**Applications:** Blink LED, Read Analog voltage, Ultrasonic range finder, Accelerometer Interfacing. | 10 | 15% |

| 7 | **Simulation of Embedded System:** Introduction to Multisim and Proteus for simulation of embedded systems & PCB design. | 2 | Practical | |
|---|---|---|---|---|
| | **Total** | **Total** | **60** | 100% |

**Reference Books:**
1. Programming 8-bit PIC Microcontrollers in C: with Interactive Hardware Simulation, by Martin P. Bates, Newnes, Elsevier.
2. Practical Aspects of Embedded System Design using Microcontrollers, by Jivan S. Parab, Santosh A. Shinde, Vinod G. Shelake, Rajanish K. Kamat, Gourish M. Naik, Springer.
3. PIC microcontrollers: 50 Projects for Beginners & Experts, by Bert Van Dam, Elektor.

**Suggested Specification table with marks (Theory):**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 20% | 25% | 35% | 10% | 10% | **0** |

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.

**Course Outcome:**
After learning the course the students should be able to:
1. Understand the basics of an embedded system, Program an embedded system, Design, implement and test an embedded system.
2. An ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.
3. Learn the programming of microcontrollers with various dedicated compilers with 'C' Language.
4. Get a Complete Design Flow of Embedded System Design with Hardware and Software designing.
5. Understand requirement of a project as well as inputs and outputs of the system

**List of Experiments: (Outlines)**

1. Introduction to MPLAB - IDE.
2. Introduction to MikroC  - IDE.
3. Introduction to Multisim for Simulation of Embedded Systems.
4. Introduction to Proteus for Simulation of Embedded Systems.
5. Interface LEDs with PIC16F877 Micro-Controller; write a C Program to Blink the LEDs and simulate the same on software.
6. Interface Buzzer & Switch with PIC16F877 Micro-Controller; write a C Program to make an Alarm system using Buzzer & Switch and Simulate the same on software.
7. Using On-Chip ADC, write a C program display the digital value of analog signal on input pin on LEDs connected to port and Simulate the same on software.
8. Interface stepper motor with PIC16F877 Controller using optoisolator; write a C program to make it operate and Simulate the same on software.
9. Interface relay & PC with PIC16F877 Controller; write a C program to control relay from PC Hyper Terminal.
10. Using Arduino UNO board, interface ultrasonic sensor with it & write a C program to use it as ultrasonic range finder.

**Design based Problems (DP)/Open Ended Problem:**
To design Embedded systems using PIC16F877 Micro-Controller and Arduino UNO board.

**Major Equipment:** PC, Arduino UNO board, PIC16F877 Micro-Controller & its Peripherals.

**Major Software:** MPLAB, MikroC, MultiSim, Proteus.

**Active Learning Assignments:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will assign topics from which students can grasp knowledge about current scenario of the Diagnostic Instrumentation. 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.