GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160311
Semester – VI
Embedded System for Medical Device

Type of course: Professional Elective Course - I

Prerequisite: Knowledge of Digital Electronics, Basic Electronics, C Language Programming, Microprocessor, Microcontroller & Applications.

Rationale: To familiarize students with concepts of Embedded Systems and give them knowledge about programming, interfacing, debugging and implementing stand-alone systems for a varied range of Biomedical Applications.

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

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction to Embedded System:** Overview of embedded systems, Characteristics of Embedded System, Classification of embedded systems, Application areas, Elements of Embedded System, Core of Embedded System, Classification of Program Memory and Working Memory, Onboard & External Communication Interfaces, Embedded Firmware, System Component	8	15
2	**Operating System Components:** Operating system service, Process management, Timer function, Event function, Memory management, Device, File and I/O subsystem management, Tasking and Scheduling Mechanism, Round - Robin, robin with Interrupts, function-One-Scheduling Architecture, Algorithms. Semaphores and shared Data Operating system Services-Message Queues-Timer Function-Events-Memory Management, Interrupt Routines in an RTOS environment, Basic design Using RTOS.	9	20

3	**Introduction to RASPBERRY PI** Overview of Raspberry Pi Platform, Applications, Board Specification, ARM vs x86 comparison, ARM Cortex -A53 Architecture, GPIO Configuration, Supported Operating System, Raspberry pi OS Setup, Advance Raspberry Pi configuration	**9**	**15**
4	**RASPBERRY PI Programming** Overview of Python Programming, Python IDE, Data types, Variables, Controlling Statement, Functions, Function as Objects, Modules, Exception handling, File read/write operation, Image read/write operation, Networking in Python, Audio playback on the RPi, Video playback on the RPi, Connecting a USB webcam, video streaming on the RPi. **Case Study:** Temperature and humidity Measurement, Bio-Signal Interfacing	**9**	**25**
5	**Computer Vision with RASPBERRY PI** Understanding of OpenCV, Installing OpenCV on an RPi board, working with images using OpenCV, matplotlib to visualize images, working with a USB webcam, Working of Pi camera module **Basic of Image Processing:** Basic Operation on Images, Arithmetic operations, Blending and transitioning Images, Negative Images, Bitwise Logical Operation	**10**	**25**
	Total	**45**	**100%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	20%	20%	15%	15%	20%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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) Introduction to Embedded Systems by K.V.Shibu, 2nd Edition,McGraw Hill.

2) Embedded System: Architecture, Programming and Design by Rajkamal,2nd edition,2010, Tata McGraw Hill
3) An Embedded Software Primer by David E. Simon, Pearson Education Asia, First Indian Reprint 2000.
4) Raspberry Pi Computer Vision Programming by Ashwin Pajankar, 2nd Edition, Packt Publishing, 2020
5) Raspberry Pi User Guide by Eben Upton, Gareth Halfacree, John Wiley & Sons (2016)
6) Computer as Components: Principles of Embedded Computing System Design, Wayne Wolf, 2nd edition,2008, Morgan Kaufmann Publication
7) Qing Li and CarolynYao," Real Time Concepts for Embedded Systems – Qing Li, Elsevier ISBN:1578201241 CMP Books © 2003

Course Outcomes:

After learning the course, the students should be able to

Sr. No.	CO statement	Marks % weightage
CO-1	To understand the aspects of Embedded Systems.	15
CO-2	To learn the Essentials components of the Operating System.	20
CO-3	To learn the ARM Cortex -A53 Architecture and setup OS for the Raspberry pi.	15
CO-4	To learn and apply the programming skills for the open Source Platform.	25
CO-5	Perform image processing operation using OpenCV on RASPBERRY PI	25

List of Experiments:

Sr. No.	Name of Experiments	Duration (Hours)
1.	Introduction of Raspberry Pi 3 B model and installing operating systems.	**2**
2.	Interfacing Led Blinking using Raspberry Pi	**2**
3.	Interfacing Switch with Raspberry Pi – Python	**2**
4.	Interfacing DS18B20 Temperature sensor with Raspberry Pi	**2**
5.	Interfacing HC-SR501 PIR Motion Sensor with Raspberry Pi	**2**

6.	Interfacing HC-SR04 Ultrasonic Sensor with Raspberry Pi	**2**
7.	Interfacing surveillance Camera for Motion Capture with Raspberry Pi	**2**
8.	Installing and Setting Up OpenCV on an RPi board	**2**
9.	Capturing images and video with the webcam	**2**
10.	Capturing images and video using Picamera with Python	**2**
11.	Perform following operations on images with Python. • Arithmetic Operations • Transition operations • Negation of image • Logical Operations	**2**

Major Equipment:

1) Raspberry Pi 3 Model B Kit
2) Usb Camera/ Picamera
3) Biomedical Sensor Kit

List of Open Source Software/learning website:

1) https://nptel.ac.in/courses/106105166/30