GUJARAT TECHNOLOGICAL UNIVERSITY

Minor Degree: Internet of Things
Subject Code: 115AI01
Semester –V
Subject Name: IoT Embedded Hardware

Prerequisite:
The students should be having knowledge of Digital Systems Design, Micro Processor and Micro Controller.

Rationale:
The knowledge of embedded systems i.e. different microcontrollers, their programming, interfacing, Linux programming, is essential for the IoT. After studying this subject students will get knowledge of AVR, PIC and ARM based microcontrollers, their architecture, interfacing and programming useful in domain of IoT.

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	0	30	0	100

Content:

Sr. No	Content	Total Hrs
1.	Introduction of AVR, PIC & ARM Series Architecture, Registers, Operation modes, Overview of instruction Set, Interrupt Management, Exception Handling, Timers, SDKs & IDEs for firmware development, Peripheral Programming (UART, GPIO,ADC, SPI, I2C, etc.), Debugging techniques, CAN basics	12
2.	Programming Languages C - Overview of C in view of IOT Devices, Pointers, Functions Arrays, Strings, Structures & Unions. Memory Allocation, Pre-processor, Linked Lists, Stacks & Queues, Sorting & Searching Techniques	8
3.	Introduction to Linux, Working with Commands Line, File System Hierarchy, vi Editor, Package Management, Administrative & Networking Essentials, Linux Internals (Process Management, Threads, File Handling, IPC), Working with Target Boards – Raspberry Pi, Beagle Bone Black etc., Native vs. Cross Building Applications, Supporting Libraries, Peripheral Management on Linux(UART, GPIO,ADC, SPI, I2C, etc)	12
4.	Introduction to Python, Scope , Data Types, Files, Functions, Modules & Packages, Standard Libraries, Data Structures, OOPs Concepts, Data Analytics related Packages	10

Suggested Specification table (Theory):

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Distribution of Theory Marks (%)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
5	20	40	5	10	**20**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi,"The AVR Microcontroller and Embedded Systems", Using Assembly and C, Pearson Education, 1st Edition, 2012.
2. Dhananjay Gadre, "Programming and Customizing the AVR Microcontroller", TMH, 1st Edition, 2001.
3. ARM Assembly Language Programming & Architecture By. Muhammad Ali Mazidi, Kindle edition.
4. Arm System Developer's Guide, Designing and Optimizing Software, Andrew N. Sloss, Dominic Symes, Chris Wwight, Elsevier.
5. Embedded Systems By. Lyla Das, Pearson publication.
6. Embedded System: Architecture, Programming and Design by Raj Kamal, 2nd Edition, TMH Publication.
7. Embedded Software Premier David Simon (Pearson).

Course Outcomes:

Upon completion of this course students should be able to:

No	Course Outcomes	% weightage
01	Review the architecture of microcontrollers used in IoT applications	UN
02	Practice for different programming techniques in C language for IoT	AP
03	Extrapolate embedded linux platform components and solve different applications using it for IoT	UN, AP
04	Quote python basic functions and test them in IoT applications	UN,AP

List of Practical:

1. Write c programs for ATMega32 Microcontroller and simulate using ATMEL Studio.
2. Interface Digital/Analog input and output devices with ATMega32 Microcontroller and write programs related to I/O applications along with IoT.
    a. Switches
    b. Relays
    c. Temperature Sensor
    d. Ultrasonic PING Sensor
    e. DC Motor
    f. Servo Motor

3. Generate PWM waveform and change intensity of LED connected with ATMega32 Microcontroller board through cloud commands.
4. Also implement above experiments using PIC18 series Microcontroller development board.
5. Understand ARM cortex based Raspberry Pi development board and configure it with OS and programming software installation.
6. Make different programs in Python on Raspberry Pi development board and interface different devices with it.
    a. Different sensor modules
    b. Camera Interface
    c. Image capturing and storing on cloud
    d. Video capturing and storing on cloud

List of Open Source Software/learning website:

- Atmel Studio
- MPLab IDE
- Python
- Raspberry pi OS
- https://www.coursera.org/specializations/iot
- https://nptel.ac.in/courses/106/105/106105193/
- https://nptel.ac.in/courses/106/105/106105166/