Faculty of Science and Technology
Savitribai Phule Pune University
Maharashtra, India

http://unipune.ac.in

Honours* in **Internet of Things**

Board of Studies
(Computer Engineering)
(with effect from A.Y. 2020-21)

Savitribai Phule Pune University

With effect from 2020-21

Honours* in Internet of Things

Year & Semester	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit Scheme		
		Theory	Tutorial	Practical	Mid-Semester	End-Semester	Term work	Practical	Presentation	Total Marks	Theory / Tutorial	Practical	Total Credit
TE & V	Embedded Systems and Internet of Things	04	--	--	30	70	--	--	--	100	04	--	04
	Embedded Systems andInternet of Things Laboratory	--	--	02	--	--	50	--	--	50	--	01	01
	Total	04	-	02	100		50	-	-	150	04	01	05
									Total	**Credits =**		**05**	
TE & VI	Internet of Things Architectures, Protocols and Systems Programming	04	--	--	30	70	--	--	--	100	04	--	04
	Total	04	-	-	100		-	-	-	100	04	-	04
									Total	**Credits =**		**04**	
BE & VII	Machine Learning for Internet of Things	04	--	--	30	70	--	--	--	100	04	--	04
	Machine Learning for Internet of Things Laboratory	--	--	02	--	--	50	--	--	50	--	01	01
	Total	04	-	02	100		50	-	-	150	04	01	05
									Total	**Credits =**		**05**	
BE & VIII	Internet of Things Security	04	-	--	30	70	--	--	--	100	04	--	04
	Seminar	--	02	--	--	--	-	--	50	50	02	--	02
	Total	04	-	02	100		-	--	50	150	06	-	06
									Total	**Credits =**		**06**	

Total Credit for Semester V+VI+VII+VIII = 20

*** <u>To be offered as Honours for Major Disciplines as–</u>**

1. Computer Engineering

2. Electronics and Telecommunication Engineering

3. Electronics Engineering

<u>For any other Major Disciplines which is not mentioned above, it may be offered as Minor Degree.</u>

Reference: https://www.aicte-india.org/sites/default/files/APH%202020_21.pdf / page 99-100

Savitribai Phule Pune University
Honours* inInternet of Things
Third Year of Engineering (Semester V)
Embedded System and Internet of Things

Teaching Scheme	Credit	Examination Scheme
Theory : 04 Hours/Week	**04**	**Mid_Semester(TH): 30 Marks** **End_Semester(TH): 70 Marks**

Companion Course, if any: -Embedded System and Internet of Things Laboratory

Course Objectives:

The main objective of this course is to introduce the students to basics of embedded systems and Internet of Things.

- To learn and understand the basics of Embedded systems.
- To be acquainted with interfacing of sensors and actuators with microprocessor.
- To design embedded systems applications.
- To understand Internet of Things and its usefulness for society.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Identify and understand the unique characteristics and components of embedded systems
CO2: Compare various development boards Arduino, Raspberry pi, Beagle bone
CO3: Implement interfacing of various sensors, actuators to the development boards
CO4: Design, implement and test an embedded system application
CO5: Configure U-Boot, Understand IoT building blocks
CO6:Compare various IoT communication technologies and Design various IoT applications

#Exemplar/Case Studies-Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

Course Contents

Unit I	ES Overview	(08 Hours)

Embedded Systems: Architecture & Characteristics of ES, Types of Embedded systems, Examples of Embedded Systems. Embedded System On Chip (SOC).
Components of ES: Hardware and software
Hardware components of ES: Power supply: types, characteristics, selection criteria, Processing Unit, **Input devices, Output Devices**

Unit II	Introduction to ES System Software	(07 Hours)

Introduction to Embedded operating Systems: Operating Systems Concepts, Real time operating systems, and, Task Scheduling, Different OS tasks, Introduction to **Real-Time Operating Systems**, characteristics, selection criteria, bootloader: U-boot.

#Exemplar/Case Studies	Case study: Raspberry Pi OS

Unit III	Sensors, Actuators and Interfacing	(09 Hours)

Sensors : Roles of Sensors & Actuators, Types of sensors ,Active and passive, analog and digital, Contact and no-contact, Absolute and relative
Working of Sensors: Position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor, camera.
Development boards: Types of boards - Arduino, Raspberry pi, Beagle bone, ESP8266, selection

criteria.
Interfacing of sensors with development boards.

Unit IV	Embedded System - Application Development	(08 Hours)
Integrated Development Platforms for Application Development in ES environment, SDLC-Requirements, Architecture, Design, Components, Coding, Testing and Deployment. Study of any two Open source IDE for ES application development with respect to any of the two indicated Case studies		
#Exemplar/Case Studies	**Design and development of ES Applications:** Object detection, Traffic signal, digital clock, robotics arm movement, fire alarm, automated disinfection tent, Bus ticketing system, Tyre pressure monitoring system, smart metering.	
Unit V	**IoT**	**(08 Hours)**
Introduction of IoT: Definition and characteristics of IoT, Technical Building blocks of IoT, Device, Communication Technologies, Data, Physical design of IoT, IoT enabling technologies, IoT Issues and Challenges- Planning, Costs and Quality ,Security and Privacy, Risks		
#Exemplar/Case Studies	**Smart Home:** Characteristics of Smart Home - Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges. **Smart Agricultural**: characteristics and applications -Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring)	
Unit VI	**Communication under IoT**	**(08 Hours)**
IoT Protocols: MQTT, CoAP, XMPP and AMQT, IoT communication models, **IoT Communication technologies**: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, LiFi, Wi-Fi, Interfacing of wifi, RFID, Zigbee,NFC with development board.		
#Exemplar/ Case Studies	**e-health**: Characteristics of e-health and applications- monitoring of health parameters, smart medicine box, elderly people monitoring, challenges. **IoT Smart City**: Characteristics and applications– Smart Economy, Smart People, Smart Goverence, Smart Mobility, Smart Environment, Smart Living Smart Grid, Smart Home, Transport and Traffic Management, Smart Healthcare	

Learning Resources

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.
2. Lyla B. Das, "Embedded Systems: An Integrated Approach" Pearson , ISBN: 9332511675, 9789332511675

Reference Books:

1. Sriram V. Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw-Hill, ISBN: 13: 9780070482845
2. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017
3. Raj Kamal, "Embedded Systems: Architecture, programming and Design", 2nd Edition, McGraw-Hill, ISBN: 13: 9780070151253
4. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 9781119958345 3.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012, ISBN:978-1-119-99435-0

Savitribai Phule Pune University
Honours* in Internet of Things
Third Year of Engineering (Semester V)
Embedded System and Internet of Things Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hrs/Week	01	Term Work: 50 Marks

Companion Course : Embedded Systems and Internet of Things

Course Objectives:

- To understand the fundamentals and functionality of various embedded board platforms.
- To design and implement interconnection and integration of sensors to embedded board platform.
- To design and implement application of IoT using various sensors.

Course Outcomes:

On completion of the course, student will be able to–

- Understand the working of embedded boards.
- Apply the knowledge to interface various sensors with IoT development board.
- Design and implement IoT system for real time applications.

Guidelines for Laboratory Conduction

- **Lab Assignments:** Following is list of suggested laboratory assignments for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The instructor may set multiple sets of assignments and distribute among batches of students. It isappreciated if the assignments are based on real world problems/applications. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.
- **Term Work**–Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct internal monthly practical examination as part of continuous assessment.
- **Assessment:**Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.
- **Laboratory Journal-** Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

Suggested List of Laboratory Experiments/Assignments

Student shouldperform at least 10 experiments with all experiments from group A and any 5 assignments fromgroup Band one from group C assignments.

(Use suitable programming language/Tool for implementation)

Sr. No.	**Group A**
1.	Study of Raspberry Pi 4, Arduino board and Operating systems for the same. Understand the process of OS installation on the Raspberry Pi.
2.	Study of different sensors:- temperature sensor, bio-sensor, IR sensor, chemical sensor(PH), gauge sensor, ultrasonic sensor etc.
3.	Understand the connection and configuration of GPIO and its use in programming. Write an application of the use of push switch and LEDs.
4.	Write an application to read temperature from the environment. If temperature crosses threshold value then it notifies with buzzer.
	Group B
5.	Interface IR sensor to Raspberry Pi/ Arduino. Write a program to detect obstacle using IR sensor and notify it using LED.
6.	Understanding and connectivity of Raspberry-Pi /Beagle board with a Zigbee module. Write anetwork application for communication between two devices using Zigbee to on and off remote led.
7.	Interface stepper motor and seven segment display with Raspberry Pi/Arduino and write a program to control the motion of motor and display number of rotation made by motor on 7 segment display.
8.	Write an application using Raspberry Pi/Arduino for streetlight control system. System consists of smart street lights that have external light sensing that automatically turns on at desired intensity based on amount of lighting needed.
9.	Write an application using Raspberry Pi/Arduino for traffic signal monitoring and control system.
10.	Write an application using Raspberry Pi/Arduino for smart health monitoring system which records heart beat rate and temperature and also sends SMS alerts if readings are beyond critical values.
11.	Implement a weather monitoring system using humidity, temperature and raindrop sensor and Raspberry Pi/Arduino board.
12.	Create a simple web interface for Raspberry-Pi/Beagle board to control the connected LEDs remotely through the interface.
	Group C
13.	Internet of things enabled real time water quality monitoring system
14.	Implement smart home automation system. The system automates home appliances and control them over internet from anywhere.
15.	Develop a Real time application like a smart home security. **Description**: When anyone comes at door the camera module automatically captures his image and sends a notification to the owner of the house on his mobile phone using GSM modem.