CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EET428	INTERNET OF THINGS	PEC	2	1	0	3

Preamble: This elective course is designed for state-of-the-art features to students and enable them to work in the industry where IoT is applied to a great extent**.** Students will also be introduced to the programming of embedded devices used in different levels of IoT application. Moreover, they will get exposed to sensor interfacing and uploading data to cloud services provided by different firms.

Prerequisite: Experience in high level language programming and system design concepts with microcontrollers are required.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the role of computer networks in IoT. (K1)
CO 2	Select the appropriate communication standard for their IoT application. (K2)
CO 3	Use the appropriate sensors and embedded devices to get the data from the "things" and upload to cloud (K2)
CO 4	Develop programs for IoT devices using micropython language. (K3)
CO 5	Utilize the learned information to find an IoT based solution for the problem at hand. (K3)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2											
CO 2	2											
CO 3	2	2			2							
CO 4	2	3	3	1	2				1			1
CO 5	2	3	3	1	2	2	1		1			1
CO 6												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	20
Understand	25	25	50
Apply	15	15	30
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Draw and explain the functional block diagram of IoT system.

2. Define the terms a) IP address b) Access point c) Station d) Router e) gateway

3. Explain the enabling technologies of IoT

Course Outcome 2 (CO2)

1. Explain the Wireless Sensor Network (WSN) technology.

2. How the data sensed from things uploaded to cloud?

3. Briefly explain the communication standards in use for connection to cloud service.

Course Outcome 3(CO3):

1. Explain the main features of Raspberry Pi 4 B computer

2. How ESP32 can be used as an embedded device in IoT applications?

3. Briefly explain the use ARM EMBED in IoT application.

Course Outcome 4 (CO4):

1. Prepare a micropython program to enable ESP32 module as an access point.

2. Prepare a micropython program to read analog data using raspberry pi and setup a server.

3. Explain the features of ARM EMBED IoT platform.

Course Outcome 5 (CO5):

1. Explain the application of IoT with suitable block diagram for smart metering of electricty

2. Detail the data sensing and prediction based on IoT applications in smart farming.

3. Detail the features of Industrial IoT with suitable block diagram.

Syllabus

EET 428: INTERNET OF THINGS

Module 1

Introduction: Definition and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT Protocols, Logical Design of IoT: IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies. Design challenges – power consumption and security issues.

Computer networks: Internet-protocols and standards-OSI model- TCP/IP protocol suite. IP addressing – IPv4 and IPv6, Physical layer components- Switch, Router, Access point, station, Server, Client, Port, Gateway. Sizing of network- LAN, MAN, WAN . **(8 hrs)**

Module 2

IoT and M2M Communications: Introduction, M2M, M2M applications, Differences between M2M and IoT, M2M standards- Bluetooth-LE, Zigbee, NFC, Wifi and LoRaWAN. Data logging and cloud services- CoAP, MQTT and JSON. Big data analytics (concepts only)**(6 hrs)**

Module 3

Sensor technologies for IoT- Wireless sensor network. Voltage, Current, Speed, Temperature and humidity sensors and data acquisition using embedded devices- block diagram. Data logging to cloud services- protocols and programming. **(6 hrs.)**

Module 4

Embedded devices for IoT. Introduction to Python programming and embedded programming using micropython. Sensor interfacing and data acquisition using target boards like Raspberry Pi 4B, ARM EMBED, ESP32, Arduino boards. Programming examples for

data logging to cloud using micropython. (Assignments on hardware implementation using these or similar boards may be given.) **(8hrs.)**

Module 5

IoT applications: Energy management and smart grid applications. IoT based home automation, Smart metering for electricity consumers. IoT based weather stations, Agriculture- smart farming, Automobile IoT- Electric vehicles-platform and software, Industrial IoT. **(6 hrs.)**

Text Books

1. Simone Cirani," Internet of things: Architecture, protocols and standards", Wiley, 2019

2. Charles Bell, "MicroPython for the Internet of Things: A Beginner's Guide to Programming with Python on Microcontrollers", Apress, 2017

3. B.K Thripathy, J Anuradha, "Internet of things (IoT) _ technologies, applications, challenges and solutions ", CRC press, 2018

4. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw Hill (India) Private Limited.

Reference Books

1. Qusay F. Hassan, " Internet of Things A to Z,: Technologies and applications", IEEE press,2018

2. Gary Smart, "Practical Python Programming for IoT : Build advanced IoT projects using Raspberry Pi 4, MQTT, RESTful APIs, WebSockets, and Python 3, Packt Publishing Ltd, 2020.

3. Gaston C. Hillar , "MQTT Essentials - A Lightweight IoT Protocol" , Packt Publishing Ltd, 2017.

4. Alasdair Gilchrist , "Industry 4.0 The Industrial Internet of Things". Apress, 2016.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module I**	
1.1	Introduction to IoT, functional block	2
1.2	IoT communication models,Design challenges	2
1.3	Computer networks related topics	4
2	**Module II**	
2.1	Introduction to M2M communications, standards	2
2.2	Data logging and cloud services, MQTT,json	3
2.3	Big data analytics (concepts only)	1
3	**Module III**	

3.1	Sensors and sensor networks	1
3.2	Voltage ,current, temperature sensors and their interfaces	2
3.3	Data logging to cloud services and protocols	3
4	**Module IV**	
4.1	Introduction to embedded devices like Raspberry Pi, ESP32 etc	2
4.2	Introduction to micropython programming	3
4.3	Micropython programming for data logging to cloud	3
5	**Module V**	
5.1	IoT applications in smart grids	3
5.2	IoT application to other applications	1
5.3	IoT applications in electric vehicles and IIoT	2