

Year: B. Tech II (Semester IV)

Subject Name: Fundamentals of Internet of Things

Subject Code: BTEA19425

Type of course: Honors (Group: Internet of Things)

Prerequisites: Microprocessor, C programming

Rationale: This course enables students to understand the basics of the Internet of things and its applications. Students will also learn about the protocols and sensors to understand the concepts of Web of Things, Python programming and interfacing for Raspberry Pi, and Design of IoT applications in different domains.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Contents	Total Hours
1.	Introduction of IoT: Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.	06
2.	Sensors, Actuators and cloud : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, Introduction to Python programming, Raspberry Pi Development Kit, RFID Principles and components, Programming of Node MCU, Implementation of IoT with Edge devices, Reading sensor data and transmit to cloud, Controlling devices through cloud	10

	using mobile application and web application, Types and configurations of gateways, Specifications of IoT gateways	
3.	Wireless Technologies for edge connectivity and protocols: WPAN Technologies for IoT, IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.	08
4.	Data Handling: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop.	05
5.	Data Analytics and Computing Using a Cloud Platform: Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications, Cloud Computing Paradigm for Data Collection, Storage and Computing, everything as a service and Cloud Service Models, IoT Cloud-based services using different platforms.	09
6.	Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	07

Suggested Specification table with Marks (Theory): (For B.Tech only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	25	15	00	00	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (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:

Sr no	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	AVR Microcontroller and Embedded Systems: Using Assembly and C	By Mazidi, Sarmad Naimi, Sepehr Naimi	Pearson ISBN 10: 0-13-800331-9 ISBN 13: 978-0-13-800331-9	2011	First Edition

2.	Internet of Things with Arduino Blueprints	Pradeeka Seneviratne	Packt Publishing Limited	2015	
3.	An Introduction: Internet of Things, Connecting Devices, Edge Gateway, and Cloud with Applications	Rahul Dubey	CENGAGE India Publication, ISBN-13: 978-93-5350-093-1 ISBN-10: 93-5350-093-1	2019	
4.	Internet of Things: Architecture and Design Principles	Raj Kamal	Mc Graw Hill Education, ISBN-13: 978-93-5260-522-4 ISBN-10: 93-5260-522-5	2017	
5.	Internet of Things (A Hands-on-Approach)	Vijay Madiseti and Arshdeep Bahga	University Press, ISBN: 978-81-7371-9547, Paperback.	2015	
6.	Beginning Sensor networks with Arduino and Raspberry Pi	Charles Bell,	Apress	2013	
7.	The Internet of Things: Enabling Technologies, Platforms, and Use Cases	Pethuru Raj and Anupama C. Raman	CRC Press		
8	Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications	Daniel Minoli	Willy Publications	ISBN: 978-1-118-47347-4,	
9	The Internet of Things: Key Applications and Protocols	Olivier Hersent, David Boswarthick, and Omar Elloumi	Wiley Publications		
10	Foundational Elements of	J. Biron and J.	O'Reilly Media	2016	

	an IoT Solution	Follett			
11	The Internet of Things: Enabling Technologies and Solutions for Design and Test, Application Note.	Keysight Technologies	Keysight Technologies	2016	

Course Outcomes:

Sr. No.	CO Statements	Marks % Weightage
CO-1	Explain the various concepts, terminologies and architecture of IoT systems	20 %
CO-2	Use sensors and actuators for design of IoT	20 %
CO-3	Describe and apply various protocols for design of IoT systems	25 %
CO-4	Use REST APIs to connect IoT related technologies	15 %
CO-5	Use various techniques of data storage in the cloud and analytics in IoT	20 %

List of Open Source Software/ Learning website:

- <https://nptel.ac.in/courses/108/105/108105102/>
- <https://www.udemy.com/course/pi-bootcamp>
- https://onlinecourses.nptel.ac.in/noc21_cs17/preview
- <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs22/>
- https://onlinecourses.nptel.ac.in/noc21_ee85/preview
- https://onlinecourses.nptel.ac.in/noc21_cs66/preview
- <https://nptel.ac.in/courses/108/108/108108098/>

List of Open-Source Software:

- Arduino 1.8.12

For Lab Sessions:

Practical List

Sr. No.	Practical Statements
1.	Study Arduino UNO Board, Node MCU (ESP8266), ESP32 and Components
2.	Installation and working with Arduino IDE. Study connection and configuration of GPIO and its use in programming. Write an application of the use of push switch and LEDs.
3.	Write a programme to read temperature from the environment. If the temperature crosses the threshold value, then it is notified with a buzzer.
4.	Interface IR sensor to Arduino. Write a program to detect obstacles using an IR sensor and notify it using LED.
5.	Write a programme for communication between two devices using Zigbee to on and off remote LED.
6.	Write a program using Arduino IDE for soil moisture data monitoring and control system.
7.	Write an application using Arduino for smart health monitoring system which records heart beat rate and temperature and also sends SMS alerts if readings are beyond critical values.
8.	Interfacing Node MCU with Cloud (Thingspeak API)
9.	Working with Adafruit Libraries in Arduino for observing various sensors and components data on cloud.

Major Equipment:

- Arduino kit, Node MCU, ESP32, Sensors, Jumper wires, USB cable, LEDs