Amrita Vishwa Vidyapeetham
Amrita School of Computing, Coimbatore.
Department of Computer Science and Engineering

2023-2024 EVEN Semester

B.Tech Elective(All Branches) – (2021-2025 Batch) **Semester: 6**

Course Summary
(At the beginning of the semester)

19CSE446 **Internet of Things** **L-T-P-C: 2-0-3-3**

(1) Faculty offering the course:
G1- Dr. V. Ananthanarayanan
G2- Prof A Baskar

(2) Syllabus with LTPC pattern.

19CSE446 **Internet of Things** **L-T-P-C: 2-0-3-3**

Pre-Requisite(s): :19CSE102 Computer Programming, 19CSE303 Embedded Systems

Course Objectives

- This course covers the fundamentals of IoT and provides skills for IoT based product development.
- The skills students learn in this subject include the selection of sensors, protocols, hardware boards, interfacing, and implementation for product building. Real life case studies are introduced in this course.

Course Outcomes

CO	Description
CO1	Understand the key techniques and theory behind Internet of Things.
CO2	Apply effectively the various enabling technologies (both hardware and software) for IoT.
CO3	Understand the integration of Cloud and IoT, Edge and Fog Computing.
CO4	Apply various techniques for Data Accumulation, Storage and Analytics.
CO5	Design and build IoT system for any one interesting Use case

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSOO1	PSO02
CO1	3	2									2	2	3	2
CO2	3	3	2	2	3		3	2	2	2	2	2	3	2

CO3	3	3	2	3	3	2	3	2	2	2	2	2	3	2
CO4	3	3	2	3	3	2	3	2	2	2	2	2	3	2
CO5	3	3	2	3	3	2	3	2	2	2	2	2	3	2

Syllabus

Unit 1

Introduction to loT - loT definition - Characteristics - Things in loT - loT Complete Architectural Stack - loT enabling Technologies - loT Challenges - loT Levels - A Case Study to realize the stack. Sensors and Hardware for loT - Accelerometer, Proximity Sensor, lR sensor, Gas Sensor, Temperature Sensor, Chemical Sensor, Motion Detection Sensor. Hardware Kits - Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

Unit 2

Protocols for loT - infrastructure protocol IPV4/V6|RPL), Identification (URLs), Transport (WiFi, LiFi, BLE), Discovery, Data Protocols, Device Management Protocols. - A Case Study with MQTT/CoAP usage. Cloud and Data analytics- Types of Cloud - loT with cloud challenges - Selection of cloud for loT applications - Fog computing for loT - Edge computing for loT - Cloud security aspects for loT applications - RFM for Data Analytics - Case study with AWS / AZURE / Adafruit / IBM Bluemix.

Unit 3

Case studies with architectural analysis: loT applications - Smart City - Smart Water - Smart Agriculture - Smart Energy - Smart Healthcare - Smart Transportation - Smart Retail -Smart waste management.

Text Book(s)

1. Vijay Madisetti, Arshdeep Bahga, “Internet of Things, A Hands on Approach", University Press.

Reference(s)

1. Shriram K Vasudevan, Abhishek SN and Sundaram RMD. Internet of Things, First Edition,Wiley India;2019.
2. Raj P, Raman AC. The Internet of things: Enabling Technologies, Platforms, and Use-cases. Auerbach Publications; 2017. Adrian McEwen. Designing the Internet of Things, Wiley;2013.

(3) Course Plan.

Lect No	Topics	Key-words	Objectives	CO	BTL
1	Course Overview	Course objective, Syllabus, Course Outcome, CO-PO mapping, Evaluation Pattern, Course Plan	To know the course proceedings	-	-
2	Introduction to IoT	M2M, CPS, WSN, IOT, WoT, IIOT 4.0	To know and appreciate need of	1	2

			Internet of Things and Industry 4.0		
Lab-1	Practice – ESP32 Introduction, Serial mode operations- print, read and write, LED blinking, LED and switch, POT sensor and AT commands				
3	IoT Definition and Characteristics	IEEE, ITU and IETF definition of IoT, Characteristics of IoT	To understand the definition of IoT by IEEE, ITU and IETF as well as the key characteristics of IoT	1	2
4	Things in IoT	Three Scopes of Things – People , Machine, Information	To understand the various scopes of Things in IoT	1	2
Lab-2	Practice – Basic Sensor capture – IR sensor, Temperature Sensor, Accelerometer, Reed Sensor, DHT sensor.				
5-7	loT Complete Architectural Stack and Levels	IoT Architecture, Hardware and Protocol Stack	To understand the hardware and software (protocol) stack of IoT and the deployment levels	1	2
Lab-3	Practice – WiFi module - AP and Station node, HTTP server, AJAX, Websocket, Bluetooth(self Study)				
8	loT enabling Technologies and Use cases	Big data, loud Computing Cognitive Computing	To understand the importance and role of various IoT enabling technologies like Big data, loud Computing Cognitive Computing	2	2
9	Introduction to Analog and Digital sensors and Actuators	IR sensor, Potentiometer, DHT, LM-35, Accelerometer/Gyroscope, servo motor, Active vs Passive sensors	To understand the working principles of various sensors and their interfacing with microcontrollers	2	3
10	IoT Cloud platforms	AWS, Azure, Google Cloud	To understand IoT connectivity, device management, application and	3	2

			analytics platforms		
11	**Tutorial -1 Design of a complete IoT solution for real world applications –**				
Lab-4	Lab Evaluation -1 (**Case Study Sprint-1: Design and Data Acquisition) –**				
11-16	IoT Data/Application Protocols	MQTT CoAP Web Sockets	To understand the operating principles of various IoT Application Protocols like MQTT, CoAP, Web Sockets	2	3
Lab-5 and 6	Practice – MQTT publish and Subscribe, NodeRed.				
Self-study	Wireless Technologies for IoT	WPAN: ZigBee, BLE, WLAN: Wi-Fi, NB-IoT, LoRa	To understand the applications of various wireless technologies for building IoT Systems	2	3
17-18	Discovery protocols in IoT	mDNS, DNS-SD	To understand the working principles and features of various Infrastructure and service Discovery protocol	4	3
Lab-7	Practice – COAP, NodeRed.				
	MID Term (Theory -20 Marks -1 Hour, Lab - 25 Marks-1.5 Hours, Viva – 5 Marks)				
19-20	Identifiers in IoT	Things identifier, Application identifier, communication identifier, user identifier, data, location and protocol identifier	To understand the integrity of accessing all the components in a IoT platform	4	2
Lab-8	Practice – UI base solution: connectivity to application server, Data acquisition and storage, data updation on web page.				

Lab-9	Practice – AWS/Azure/Google Cloud – creating things, device provisioning, streaming, database connectivity, data analytics.				
Lab-9	Lab evaluation -2 **(Case Study Sprint-2: Communication protocols and Data Storage in cloud)**				
21-22	Device Management Protocols for IoT	provisioning and authentication, configuration and control, monitoring and diagnostics, and software updates and maintenance	To understand the working principles and features of various Device management	4	2
Lab-11	Practice – AWS/Azure/Google Cloud – creating things, device provisioning, streaming, database connectivity, data analytics.				
23-24	Cloud and Data Analytics	Cloud and IoT Big Data, Data Analytics	To understand the integration of Cloud and IoT, Big Data and Tools for Data Analytics	3	3
Lab-12	Practice – AWS/Azure/Google Cloud – creating things, device provisioning, streaming, database connectivity, data analytics.				
25	Fog computing for loT	Fog Computing, Cloud Computing	To understand the essentials of Fog Computing	3	2
26	Edge computing for loT	Edge Computing, Cloud Computing	To understand the essentials of Edge Computing	3	2
Lab-13	Practice – AWS/Azure/Google Cloud – creating things, device provisioning, streaming, database connectivity, data analytics.				
27-28	RFM for Data Analytics	Recency, Frequency, Monetary analytics	To understand the RFM for Data Analytics related with an IoT use case	3	3
Lab-14	Lab Evaluation -3 **(Case Study Sprint-3: Discovery services, device provisioning and update services, and Data Analytics in cloud)**				
29-30	Use case Discussion	Case study from various domains like Health Care, Smart Home, Smart Transportation	To demonstrate the working and design principles of IoT Applications.	5	3

End Semester Examination (lab based) - – Theory (45 Marks) + Lab (40 Marks) –Viva-15 Marks

(1.5 hrs theory and 1.5hr lab)

(4) Evaluation Pattern. Internal: External –70:30 pattern

S.No	Components	Weightage
	Internal	
1	Mid Term	20
2	Continuous Assessment Theory Tutorial -1 Design of a complete IoT solution for real world applications	10
3	Continuous Assessment Lab ● Evaluation-1 (Case Study Sprint-1: Design and Data Acquisition) ● Evaluation– 2 (Case Study Sprint-2: Communication protocols and Data Storage in cloud) ● Evaluation-3 (Case Study Sprint-3: Discovery services, device provisioning and update services, and Data Analytics in cloud)	10 15 15
	External	
4	End Semester Exam	30
	Total	100

(5) Suggestions received from previous mentor and the changes incorporated.

Department of Computer Science and Engineering
Amrita School of Engineering, Coimbatore
Course Feedback Summary
Academic Year: 2021-2022 **Semester: Even**

Course (Code and Title): 19CSE446 Internet of Things

Semester: 6 Programme: B.Tech CSE

Course Mentor: Mr. A. Baskar

Faculty Name: Mr. A. Baskar

Positive points on conduct of this course: (add as many rows as required.)

Sno	Details
1	Students developed various real time IoT use cases and showcased their demo to Juniors in IoT Demo Day Edition2
2	IoT Demo Day Edition2 helped student to understand various real time challenges of their use case

Suggestions for improvement in the next iteration of this course

S.No	Details
1	IoT Demo day next Edition need to focus on real time use case implementation for university needs and same supposed to be deployed in university
2	It is requested to keep the IoT lab open till 8.00pm on all working days when the course is offered in the campus.
3	Latest hardware modules should be used for subsequent offering of the course

Signature of Course Mentor

for N-[illegible] 20/10/22

Signature of Chairperson

(Dept. of Computer Science and Engineering
School of Computing
Amrita Vishwa Vidyapeetham
Amritanagar P.O., Coimbatore-641 112.)

Action Plan:

1. List of real time for university needs will be supplied for case study.
2. Hardware purchase left to students.
3. Centralized hardware has more equipment's hence the components will be used from that lab.

Course Feedback Summary

Academic Year: 2022-2023 **Semester (odd)**

Course (Code and Title): 19CSE446 Internet of Things

Semester: VI **Programme:** B.Tech

Course Mentor: Nalinadevi K

Faculty Team: G1 - Dr.V.Ananthanarayanan , G2 - Ms. K Nalinadevi

Positive points on the conduct of this course: (add as many rows as required.)

S.No	Details
1	The students have done a case study exploring the basic data capture in a smart environment with sensors, storage of data in a cloud, data visualization, comparison of edge and cloud computing for application decision making and IoT analytics. The case study
2	The course has also provided a hands-on experience on a variety of sensors and communication modules.
3	The course also provided a complete study of the IoT architecture and protocols in the theory.
4	The course provided the access to AWS cloud for exploring all the services for performing a complete project in IoT.

Suggestions for improvement in the next iteration of this course (add rows if required)

S.No	Details
1	The course content can explore more of continuous inhouse projects to improve rather than starting a project fresh in each iteration.
2	The midterm exam can be a theory-based exam and the end semester exam can be a term project evaluation.

Department of Computer Science and Engineering

Amrita School of Engineering, Coimbatore

Course Feedback Summary

Academic Year: **2023-2024** **Semester (odd)**

Course (Code and Title): 19CSE446 Internet of Things

Semester: VI **Programme:** B.Tech

Course Mentor: Dr V Ananthanarayanan

Faculty Team:

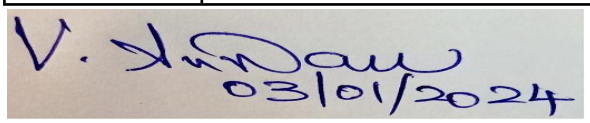
1. G1 - Dr.V.Ananthanarayanan

Positive points on the conduct of this course: (add as many rows as required.)

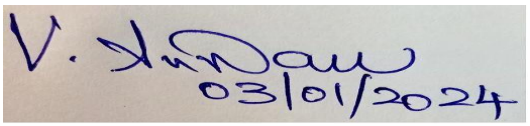
S.No	Details
1	The students have done a case study exploring the basic data capture in a smart environment with sensors, storage of data in a cloud, data visualization, comparison of edge and cloud computing for application decision making and IoT analytics. The case study
2	The course has also provided a hands-on experience on a variety of sensors and communication modules.
3	The course also provided a complete study of the IoT architecture and protocols in the theory.
4	Based on the inputs from ICPro, we introduced InfluxDB as RTDB and Grafana as an IoT Dashboard.

Suggestions for improvement in the next iteration of this course (add rows if required)

S.No	Details
1	The course content can explore more of continuous inhouse projects to improve rather than starting a project fresh in each iteration.
2	Previous batch IoT projects will be considered for bringing the PoC into Product Form.



Signature of Course Mentor



Signature of Faculty Team

Signature of Chairperson

(6) List of software and hardware tools and platforms.

S.No	Tools
1	Software Tools: 1. Arduino IDE 2. WAMP/LAMP server 3. Node-Red
2	Cloud Environment: AWS /Azure/ Thinkspeak / Adafruit cloud login RTDB : InfluxDB IoT Dashboard: Grafana
3	Hardware: 1. ESP-32(120 Nos), BYOD Model 2. Basic sensors-DHT, DS18B20, LM-32, PIR, Triaxial Accelerometer and gyroscope (40 sets) 3. Raspberry Pi 3 (20 Nos). 4. NRF24L01, LoRa, 4G / NB-IoT Communication Modules

(7) Highlight on any other innovative practise added newly to show continuous improvement in the course delivery,

Mini project to be done by teams on different real time applications of ML / AI in Internet of Things and Cyber Physical Systems.

IoT Demo Day.