B.Tech. Fourth Year

Course Handout

Session (Semester): July 2024 to December 2024

Branch: Information Technology

Class: Theory Course

Course Name (Code): Internet of Things (IT_4050)

Contact Hours/Week:

L	T	P	C
3	0	0	3

Course Coordinator: Dr.Preethi

Course Instructor: Dr.Preethi

A. Introduction: The goal is to understand the principles of internetworking of embedded devices and to learn the state-of-the-art architectures for the Internet of Things (IoT). This includes understanding various technologies and protocols that enable the formation of highly distributed and ubiquitous networks of seamlessly connected heterogeneous devices, fully integrated into the current Internet. Additionally, the focus is on analyzing and visualizing sensor data to derive meaningful insights.

B. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	In-sessional Exam I (Close Book)***	30
	Quizzes*	10
	Activities**	10
End Term Exam (Summative)	End Term Exam (Close Book)**** As per MAHE-MIT Manipal guidelines	50

	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination, but this attendance limit is not mandatory for the online classes as guided by AICTE. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

No. of Quizzes	**Week**	**Pattern**	**Marks**	**Mode**	**Duration**
Quiz-1	4th Week (12th Aug-30th Aug 2024)	10 MCQs (Each of 01 marks)	10 Marks	Hardcopy sheets Online (LMS)	30 minutes during the respective class hour

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No of Activities	Week	Pattern	Marks
Activity 1	15th Week (7th-23rd April 2024)	Review Article/ Project based writing	10 Marks

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No. of In-Sem Exams	Week	Pattern	Marks	Total
In-sem Exam (Regular)	4th Week (12th Aug-30th Aug 2024)	**1. MCQs** (10 Questions, each 1 mark)	10 Marks	10 marks
In-sem Exam (Regular)	15th Week (7th-23rd April 2024)	**2. Activity**	10 Marks	10 marks
In-sem Exam (Regular)	10th Week ((23-30)September 2024	**3 . Midterm**	30 Marks	30 Marks

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No. of End-Sem Exams	Week	Pattern	Marks	Total
End-semExam (Regular)	BetweenMay	Comprehensive examination covering fullsyllabus. Students areexpected to answer all questions	Answer all 5full questions of 10 markseach. Each question will have 2 to 3 parts of 3/4/5/6/7 marks	50 marks

C. Syllabus:

MODULE 1 : INTRODUCTION

M2M Communication, IoT, M2M value chain, IoT value chain, an emerging industrial structure for IoT, Implications for IoT, Barriers and concern, IoT use case example. [3 Hours]

MODULE 2: M2M TO IOT – AN ARCHITECTURAL OVERVIEW

An IoT architecture outline, Standards considerations. IoT data Management, IoT architecture-State of art solution, IoT reference model, IoT deployment and operational view. [7 Hours]

MODULE 3: IOT PHYSICAL DEVICES AND ENDPOINTS

Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, interfaces, Programming Raspberry Pi with Python. IoT physical servers and cloud offerings: introduction to cloud storage models and communication Networks, REST APIs along with HTTP, MQTT and AMQP protocols [6 Hours]

MODULE 4: IOT ENABLING TECHNOLOGIES

M2M: The Internet of Devices, RFID: The Internet of Objects, WSN: The Internet of Transducers, SCADA: The Internet of Controllers. Web of Things versus Internet of Things, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards [10 Hours]

MODULE 5:ANALYTICS FOR THE IOT

Data flows from the IoT device to the final data set, Develop techniques to wring value from IoT data, apply geospatial analytics to IoT data, Use machine learning as a predictive method on IoT data. [6 Hours]

MODULE 6: REAL-WORLD DESIGN CONSTRAINT

Technical design constraints, IoT devices and networks, data representation and visualization, interaction and remote control. [2 Hours]

MODULE 7: IOT USE CASES

Ubiquitous IoT Applications, Telematics and Intelligent Transport Systems, Smart Grid and Electric Vehicles, Smarter Planet and Smart Buildings, Home Healthcare and Remote patient Monitoring. [2 Hours]

D. References:

R1. Holler J., Tsiatsis V., Mulligan C., Karnouskos S., Boyle D., From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence (1e), Elsevier 2014.

R2. Bahga A., Madisetti V., Internet of Things-A Hands on Approach (1e), Orient Blackswan Private Limited, 2015.

R3. Roderick O., Marko N., Sanchez D. and Aryasomajula A., Internet of Things and Data Analytics Handbook (1e), Wiley-Blackwell, 2017.

R4. Patil Y., Azure IoT Development Cookbook (1e), Packt publishing Ltd, 2017.

R5. Minteer A., Analytics for the Internet of Things (1e), Packt publishing Ltd, 2017.

Course Outcomes:

At the end of the course, students will be able to:

CO1: Demonstrate internetwork between embedded devices through the Internet.

CO2: Apply the concept of IoT to a particular sensor-based network.

CO3: Choose the appropriate network architecture for a particular application.

CO4: Analyse and design networks to support the development of intelligent services with given performance requirements in a variety of application domains.

CO5: Assess different Internet of Things technologies and their applications.

E. Program Outcomes and Program Specific Outcomes

[PO.1]. Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO.2]. Problem Analysis: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences**.**

[PO.3]. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

[PO.4]. Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions**.**

[PO.5]. Modern Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modelling to complex engineering activities with an under- standing of the limitations.

[PO.6]. The Engineer and Society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO.7]. Environment and Sustainability: Understand the impact ofprofessional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

[PO.8]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice**.**

[PO.9]. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and designdocumentation, make effective presentations and give and receive clear instructions**.**

[PO.11]. Project Management and Finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to owners own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

[PO.12]. Life-long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO

PSO1: Apply Mathematical models and programming concepts to solve real world problems for Evolving Technology

PSO2: Demonstrate the skills towards the domain specific initiatives of Information Technology

PSO3: Demonstrate the ability of team work, communication and documentation skills in designing and implementation of software products

PSO 4: Understanding of ethical, legal, and social issues related to areas of information technology.

F. Lecture Plan

L. No.	Topics	Course Outcome Addressed
L0	Introduction to the course	CO
L1	Introduction: M2M Communication, IoT	CO1
L2	M2M value chain, IoT value chain, an emerging industrial structure for IoT	CO1
L3	Implications for IoT, Barriers and Concern, IoT use case example.	CO1
L4	M2M to IoT – An Architectural Overview	CO1
L5	An IoT architecture outline	CO1
L6	Standards considerations	CO1
L7	IoT data management	CO2
L8	IoT architecture-State of the art solution	CO2
L9	IoT reference model	CO2
L10	IoT deployment and operational view.	CO2
L11	IoT Physical devices and endpoints: Basic building blocks of an IoT	CO2
L12	Exemplary Device: Raspberry Pi, interfaces,	CO2
L13	Programming Raspberry Pi with Python	CO2
L14	Device IoT physical servers	CO2
L15	Cloud offerings: introduction to cloud storage models and Communication Networks	CO2
L16	REST APIs along with HTTP, MQTT and AMQP protocols	CO2
L17	IoT Enabling Technologies:M2M: The Internet of Devices	CO2
L18	RFID: The Internet of Objects	CO2
L19	RFID: The Internet of Objects	CO2
L20	WSN: The Internet of Transducers,	CO3
L21	SCADA: The Internet of Controllers	CO3
L22	SCADA: The Internet of Controllers	CO3
L23	Web of Things versus Internet of Things	CO4

L24	M2M and WSN Protocols	CO4
L25	SCADA and RFID Protocols	CO4
L26	Issues with IoT Standardization, Unified Data Standards	CO4
L27	Analytics for the IoT: Data flows from the IoT device to the final data set	CO4
L28	Data flows from the IoT device to the final data set	CO4
L29	Develop techniques to wring value from IoT data, apply geospatial analytics to IoT data	CO4
L30	Develop techniques to wring value from IoT data, apply geospatial analytics to IoT data	CO5
L31	Use machine learning as a predictive method on IoT data.	CO5
L32	Use machine learning as a predictive method on IoT data.	CO5
L33	Real-world Design Constraint: Technical design constraints, IoT devices and networks,	CO5
L34	Data representation and visualization, interaction, and remote control.	CO5
L35	IoT Use Cases: Ubiquitous IoT Applications, Telematics and Intelligent Transport Systems, Smart Grid and Electric Vehicles	CO4
L36	Smarter Planet and Smart Buildings, Home Healthcare and Remote Patient Monitoring.	CO4

G. Course Articulation Matrix (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES											
		PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
IT_4050.1	Demonstrate internetwork between embedded devices through the Internet.	3	3	3	2	2	1						
IT_4050.2	Apply the concept of IoT to a particular sensor-based network.	1				1			1				1
IT_4050.3	Choose the appropriate network architecture for a particular application.		3	1	2	1		1		1			
IT_4050.4	Analyse and design networks to support the development of intelligent services with given performance requirements in a variety of application domains.		1	2	2			1		2	1	1	
IT_4050.5	Assess different Internet of Things technologies and their applications	1			2	1	1			1		1	

Note: CO to PO & PSO mapping level (1 – low, 2- moderate and 3 – substantial). PSO (If Applicable)

Submitted By: (Dr. Preethi) HOD Director