Amrita Vishwa Vidyapeetham
Amrita School of Engineering, Coimbatore

Department of Electrical and Electronics Engineering

Course Plan

Academic year: ***2024-25*** Semester : *II*
Department : *Electrical & Electronics Engineering* Program : M.*Tech. Embedded Systems*
Course Code : 21ES614 Course Title : *Internet of Things*

Course Outcomes and its Mapping with POs

CO	Course Outcomes	PO1	PO2	PO3	PSO1	PSO2
CO1	Understand the concepts and principles of IoT.	1		1	3	
CO2	Implement communication protocols related to IoT and machine to machine communication (M2M)	3	1	2	3	
CO3	Familiarize key technologies in an IoT framework.	1		1	3	2
CO4	Develop IoT based solution for real world applications.	3	1	3	1	2

Syllabus:

Unit 1

Introduction to IoT - Definitions, frameworks and key technologies. Functional blocks of IoT systems: hardware and software elements- devices, communications, services, management, security, and application. Challenges to solve in IoT.

Unit 2

Basics of Networking & Sensor Networks - Applications, challenges - ISO/OSI Model, TCP/IP Model. Sensor network architecture and design principles. IoT technology stack -overview of protocols in each layer. Communication Protocols. Communication models, Application protocols for the transfer of sensor data. Infrastructure for IoT: LoRa-Wan, 6LoWPAN, 5G and Sigfox. Operating systems and programming environments for embedded units (Contiki).

Unit 3

Introduction to Cloud, Fog and Edge Computing- Modern trends in IoT – Industrial IoT, Wearable. Applications of IoT - Smart Homes/Buildings, Smart Cities, Smart Industry, and Smart Medical care, Smart Automation etc.

Text Book/ Reference Materials:

1. Andrew S. Tanenbaum and David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2011.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley and Sons Ltd., 2005.
3. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2012.
4. Rayes, Ammar, Salam, Samer "Internet of Things from Hype to Reality" 2nd edition, Springer, 2018.
5. Boris Adryan, Dominik Obermaier, Paul Fremantle "The Technical Foundations of IoT" Artech House 2nd edition, 2017.

Additional References

1. https://nptel.ac.in/courses/106105166 or https://archive.nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/106105195

Course Plan:

Lecture No.	Module	Study Material	Tentative Date	CO	Remarks
45 lecture hours, 12 lab sessions, 4 lab experiment evaluations, 1 mid-term examination, 1 project					
	Course Introduction, Syllabus, COs, Books, Evaluation Pattern.	PPT, Links, NPTEL Lectures, Textbooks by Adryan, Ammar and Tanenbaum.	4 Dec 2024		2 lab evaluations before mid-term
1	Introduction to IoT		6 Dec 2024	CO01	
2	Basics of Networking		9 Dec 2024	CO01	
3	Definitions, frameworks		11 Dec 2024	CO01	
4	Key technologies		13 Dec 2024	CO01	
5	Functional blocks of IoT systems		14 Dec 2024	CO03	
6	Sensors		16 Dec 2024	CO03	
7	Actuators		18 Dec 2024	CO03	
8	Interfaces		20 Dec 2024	CO03	

9	End & Edge Nodes		23 Dec 2024	CO04	
10	Cloud, Fog & Edge Computing		27 Dec 2024	CO01	
11	IoT Communication		28 Dec 2024	CO01	
12	Communication Models		30 Dec 2024	CO04	
13	Services & Management		3 Jan 2024	CO01	
14	Security		4 Jan 2024	CO01	
15	Application & Challenges		6 Jan 2024	CO01	
16	IoT Technology Stack	PPT, Links, NPTEL lectures, and Textbooks by Karl, Hersent, Tanenbaum and Adryan	8 Jan 2024	CO01	
17	IoT Design Levels		10 Jan 2024	CO01	
18	IoT Design Levels		22 Jan 2024	CO03	
19	ISO OSI		24 Jan 2024	CO02	
20	ISO OSI		25 Jan 2024	CO02	
21	TCP/IP		27 Jan 2024	CO02	
22	M2M and Sensor Networks		29 Jan 2024	CO02	
22 Lecture hours, 7 Lab sessions, 2 Lab Evaluations, 1 Mid-Term Examination					
23	Sensor Networks Characteristics	PPT, Links, NPTEL lectures, and Textbooks by Karl, Hersent, Tanenbaum and Adryan	31 Jan 2024	CO02	2 lab evaluations after mid-term
24	Sensor Network Protocol Stack		12 Feb 2024	CO03	
25	Sensor Network Design Principles		14 Feb 2024	CO03	
26	Sensor Network Design Principles		17 Feb 2024	CO03	
27	Overview of protocols - Physical layer		19 Feb 2024	CO03	
28	Overview of protocols - Physical layer		21 Feb 2024	CO03	
29	Overview of protocols – Data Link layer		24 Feb 2024	CO03	
30	Overview of protocols – Data Link layer		26 Feb 2024	CO03	

31	Overview of protocols – Data Link layer	PPT, Links, NPTEL Lectures, Textbook by Adryan, Ammar, and Hersent	28 Feb 2024	CO03	
32	Overview of protocols – Network layer		3 March 2024	CO03	
33	Overview of protocols – Network layer		5 March 2024	CO03	
34	Overview of protocols – Transport layer		7 March 2024	CO02	
35	Overview of protocols – Transport layer		8 March 2024	CO02	
36	Application protocols for the transfer of sensor data - MQTT		10 March 2024	CO02	
37	Application protocols for the transfer of sensor data - MQTT		12 March 2024	CO02	
38	HTTP		14 March 2024	CO02	
39	Application protocols for the transfer of sensor data - CoAP		17 March 2024	CO02	
40	Application protocols for the transfer of sensor data - CoAP		19 March 2024	CO03	
41	Other Application protocols for the transfer of sensor data		21 March 2024	CO03	
42	Communication Technologies		24 March 2024	CO04	
43	Communication Technologies		26 March 2024	CO04	
44	Modern Trends & Case Studies		28 March 2024	CO04	
45	Modern Trends & Case Studies		29 March 2024	CO04	

23 Lecture hours, 6 Lab sessions, 2 Lab Evaluations, 1 Project

Evaluation (100):

Internal: Lab Evaluations 30 marks (4 evaluations, 2 before and 2 after Mid-Term Examination, for 7.5 marks each), 1 Mid-Term Examination 30 marks (Conducted out of 50 and converted to 30 marks)

External: Project 40 marks (Solution 7.5 marks, Nodes 7.5 marks, Server 7.5 marks, Concepts – 7.5 marks, Report 10 marks) :::: Total Internal – 60, External - 40

Lab & Project Plan:

Session No:	Experiment	Date	COs	Remarks
	Introduction	9 Dec 2024		
1	Familiarization of various communication networks in NetSim and Wireshark	14 Dec 2024	CO1, CO2, CO3, CO4	Practice
2	**IoT end nodes with Ubidots, Adafruit, ThingSpeak**	16 Dec 2024		Practice
	Sensing – Data – Analog, Digital, via protocol; Processing; Actuation – On/Off, Continuous;	23 Dec 2024		Practice
	Signal conditioning circuit; Communication. Platforms – Data display, control initiation.	30 Dec 2024		**Evaluation**
4	Simulation study on IEEE 802.3/802.11 networks using NetSim	6 Jan 2024		Practice
5	Simulation study on ZigBee/Wireless Sensor Networks using NetSim	20 Jan 2024		Practice
6	**IoT networks simulation in NetSim & Wireshark packet data extraction**	25 Jan 2024		**Evaluation**
7	Familiarization of socket connection using microcontroller board and PC/Laptop	27 Jan 2024	CO1, CO2, CO3, CO4	Practice
8	IoT edge node – Data aggregation and communication	17 Feb 2024		Practice
9	IoT edge node – Edge computing and communication	24 Feb 2024		Practice
	Demonstration of IoT edge device – aggregation, edge computing & communication	3 March 2024		**Evaluation**
10	Implementation of UI for data visualization & remote control	10 March 2024		Practice
11	Implementation of database for edge/end node data storage	17 March 2024		Practice
12	Implementation of a server with database and UI	24 March 2024		**Evaluation**
13	Project Implementation	5 April 2024	CO1, CO2, CO3, CO4	**Evaluation**

See the rubrics document for more details on evaluation and lab experiments document for details on lab experiments.