

Subject: **Introduction to IoT**

Subject Code: **20CS5T02**

Common to CSM-C & AIML

Course objectives: The main objectives are

1. Introducing the IoT related sensors, infrastructural and networking technologies.
2. Understand various modules and protocols used in IoT environment.
3. Understand the core technologies behind IoT.
4. Encourage analysis, design, and development of IoT applications.
5. Identify the real-world scenarios and apply the IoT solutions for a better solution.

Course Outcomes: Upon successful completion of the course, the student will be able to

CO1: Identify the basic building blocks of Internet of Things.

CO2: Design and develop protocols and modules for IoT applications.

CO3: Understand and implement the technologies required for the development of IoT applications.

CO4: Implement applications based on sensors and other microcontroller boards.

CO5: Build cloud based IoT applications in real-time.

DETAILED SYLLABUS:

UNIT-1: Introduction:

Definition and Characteristics of IoT, IoT Architectures, Challenges and Issues, Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.

UNIT-II: Control units:

Communication modules – Bluetooth – Zigbee – Wi-Fi, IoT Application and Network Layer Protocols (Wired Communication, Power Sources.

UNIT-III: Four Pillars of IoT Paradigm:

RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M, IoT Enabling Technologies – Big Data Analytics – Cloud Computing – Embedded Systems.

UNIT-IV: IoT System Design:

Working principles of sensors, IoT deployment for Raspberry Pi /Arduino/Equivalent platform, Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, wifi and USB, Contiki OS, Cooja Simulator, Clustering – Clustering for Scalability – Clustering Protocols for IoT.

UNIT-V: API Development Tools:

Python based API development, Set up cloud environment – Cloud access from sensors, Data Analytics for IoT, Case studies- Smart Healthcare – Smart Cities – Other recent projects.

TEXTBOOKS:

1. Vijay Madisetti, ArshdeepBahga, Internet of Things, “A Hands-on Approach”, University Press
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs

REFERENCEBOOKS:

1. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press
2. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
3. Adrian McEwen, “Designing the Internet of Things”, Wiley
4. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill

ONLINE REFERENCES:

1. <https://www.edx.org/course/introduction-to-the-internet-of-things>
2. <https://www.simplilearn.com/learn-iot-basics-skillup>
3. <https://online.stanford.edu/courses/xee100-introduction-internet-things>
4. https://onlinecourses.nptel.ac.in/noc22_cs53

e-resources:

1. <https://www.coursera.org/specializations/iot>
2. <https://www.edx.org/learn/iot-internet-of-things>
3. <https://nptel.ac.in/courses/106/105/106105166/>

MICRO-SYLLABUS:

Unit-1: Introduction (10 hrs)		
Definition and Characteristics of IoT, IoT Architectures, Challenges and Issues, Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.		
Unit	Module	Micro Content
I	Definition and characteristics of IoT	Definitions
		Characteristics
	IoT Architecture	Layered models – Four, Five and Six layered architectures
		General Cloud Architecture
	Challenges and Issues	Challenges
		Issues
	Physical Design of IoT	Physical Devices
		IoT protocols
	Logical Design of IoT	IoT Functional Blocks
		IoT Communication Models: Publish-Subscribe, Push-Pull, Request-Response, Exclusive Pair.
		IoT Communication APIs: REST and Web sockets-based APIs.
		Security in IoT
Unit-2: Control units (9 hrs)		
Communication modules – Bluetooth – Zigbee – Wi-Fi, IoT Application and Network Layer Protocols, Wired Communication, Power Sources		
Unit	Module	Micro Content
II	Communication Modules	Bluetooth
		Zigbee

		Wi-Fi
	Application Layer Protocols	MQTT
		AMQP
		CoAP
		HTTP
		DDS
		XMPP
	Network Layer Protocols	IPv6
		6LoWPAN
	Wired Communication	Ethernet
	Power Sources	Renewable Energy Sources
		Non-Renewable Energy Sources

Unit-3: Four Pillars of IoT Paradigm (10 hrs)

RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IoT Enabling Technologies – Big Data Analytics, Cloud Computing, Embedded Systems.

Unit	Module	Micro Content
III	Four Pillars of IoT	RFID
		Wireless Sensor Networks (generic architecture)
		SCADA
		M2M
	IoT Enabling Technologies	Big Data Analytics
		Cloud Computing
		Embedded Systems

Unit-4: IoT System Design (10 hrs)

Working principles of sensors, IoT deployment for Raspberry Pi /Arduino/Equivalent platform, Reading from Sensors, Communication:

Connecting microcontroller with mobile devices, communication through Bluetooth, wifi and USB - Contiki OS Cooja Simulator. Clustering, Clustering for Scalability, Clustering Protocols for IoT.

Unit	Module	Micro Content
IV	Working Principles of Sensors	Sensors, types
		Working of – Temperature, Humidity, Light, Ultrasonic, PIR, and other sensors.
	IoT Deployment	Arduino based design
		Raspberry Pi based design
		Reading from sensors (Sensors interfacing)
	Communication	Connecting microcontroller with mobile devices using Bluetooth
		Connecting microcontroller with mobile devices using Wi-Fi.
	Contiki OS	OS Functionalities
		Protothreads
		Protocols supported by Contiki
	Cooja Simulator/Emulator	Features
	Clustering	Need for clustering – Scalability
		LEACH protocol
		Adaptive LEACH protocol

Unit-5: API Development Tools (9 hrs)

Python based API development, Set up cloud environment –Cloud access from sensors– Data Analytics for IoT- Case studies- Smart Healthcare – Smart Cities – Other recent projects.

Unit	Module	Micro Content
V	Python based API	Python APIs for cloud access

	development	Accessing cloud from the device
		Sensor data storage in cloud
	Data Analytics for IoT	The 4-V's of Data analytics
		Challenges in Data analytics
		Data analytics framework for IoT
	Case Studies	Open-source e-healthcare platform
		Beclose elderly monitoring
		Smart agriculture
		Smart home

CO – PO Matrix Table:

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2								
CO2			3		2						2	
CO3	3		2				2					
CO4			3		2				2			
CO5			3							2	2	

MODEL PAPER
III B. TECH I SEMESTER
INTRODUCTION TO IOT
(CIC)

Time: 3 Hours

Max. Marks: 70

Note: Answer **ONE** question from each unit (**5 × 14 = 70 Marks**)

~~~~~

| UNIT-I   |    |                                                                                                                                                                       |      | CO | BL |
|----------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----|----|
| 1.       | a) | Define the Internet of Things (IoT) and elaborate on its three primary characteristics.                                                                               | [7M] | 1  | 1  |
|          | b) | Explain in detail the four layered architecture of IoT with a neat diagram.                                                                                           | [7M] | 1  | 2  |
| (OR)     |    |                                                                                                                                                                       |      |    |    |
| 2.       | a) | Examine major challenges in IoT implementation and explain each of them.                                                                                              | [7M] | 1  | 1  |
|          | b) | Explore the logical design of IoT, focusing on functional blocks and communication models such as Publish-Subscribe, Push-Pull, Request-Response, and Exclusive Pair. | [7M] | 1  | 2  |
| UNIT-II  |    |                                                                                                                                                                       |      |    |    |
| 3.       | a) | Explain the importance of networking protocol IPv6 in IoT context.                                                                                                    | [7M] | 2  | 2  |
|          | b) | Describe the basic components of a Wi-Fi network and how Wi-Fi devices connect to it                                                                                  | [7M] | 2  | 1  |
| (OR)     |    |                                                                                                                                                                       |      |    |    |
| 4.       | a) | Explain the primary purpose of the AMQP (Advanced Message Queuing Protocol) in network communication                                                                  | [7M] | 2  | 3  |
|          | b) | Describe the significance of Ethernet as a wired communication standard.                                                                                              | [7M] | 2  | 4  |
| UNIT-III |    |                                                                                                                                                                       |      |    |    |
| 5.       | a) | Discuss the importance of Big Data Analytics in IoT. How does it help in extracting value from IoT-generated data?                                                    | [7M] | 3  | 4  |
|          | b) | Explain the generic architecture of Wireless Sensor Networks (WSNs) and how they contribute to IoT applications.                                                      | [7M] | 3  | 2  |
| (OR)     |    |                                                                                                                                                                       |      |    |    |
| 6.       | a) | What is SCADA, and how does it support the Four Pillars of IoT? Provide a brief overview.                                                                             | [7M] | 3  | 2  |
|          | b) | Describe the fundamental concept of Radio-Frequency Identification (RFID) and its role in the Internet of Things (IoT).                                               | [7M] | 3  | 2  |
| UNIT-IV  |    |                                                                                                                                                                       |      |    |    |
| 7.       | a) | Explain the working principles of different types of                                                                                                                  | [7M] | 4  | 2  |

|        |    |                                                                                                                                                                              |      |   |   |
|--------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---|---|
|        |    | sensors. Provide examples of specific applications for temperature, humidity, and light sensors.                                                                             |      |   |   |
|        | b) | What are the key components of a Raspberry Pi -based IoT design? How does it differ from an Arduino -based design?                                                           | [7M] | 4 | 3 |
| (OR)   |    |                                                                                                                                                                              |      |   |   |
| 8.     | a) | Explain the concept of Protothreads in Contiki OS and how they aid in multitasking on resource-constrained devices.                                                          | [7M] | 4 | 4 |
|        | b) | Explain the necessity for clustering in IoT networks, particularly with regard to scalability. Provide a brief overview of why clustering is essential.                      | [7M] | 4 | 2 |
| UNIT-V |    |                                                                                                                                                                              |      |   |   |
| 9.     | a) | What are the "4-V's" of data analytics, and how do they relate to IoT data? Explain the significance of each "V."                                                            | [7M] | 5 | 2 |
|        | b) | Discuss a case study in smart agriculture. How does IoT technology contribute to improved agricultural practices and resource management?                                    | [7M] | 5 | 4 |
| (OR)   |    |                                                                                                                                                                              |      |   |   |
| 10.    | a) | Describe the significance of cloud computing in the context of IoT.                                                                                                          | [7M] | 5 | 2 |
|        | b) | Describe a smart home case study where IoT is used to create a connected and automated home environment. What are the practical benefits of this technology in daily living? | [7M] | 5 | 4 |

\* \* \* \* \*