

NATURE SCIENCE FOUNDATION

Coimbatore – 641 004, Tamil Nadu

Course Title: Industrial Internet of Things	
Mode of Delivery: Physical Classroom Training	Type of Learning: Lectures, Industry Study, Case Study & Student Activity
Total Learning Hours: 60	Total Marks: 75

Prerequisites

Basic knowledge computer networks and related courses.

Learning Objectives

1. To understand the fundamentals of IIoT and its role in modern industries.
2. To explore IIoT architecture, protocols, and key enabling technologies.
3. To analyze various IIoT applications across industries like manufacturing, energy, and logistics.
4. To gain practical knowledge of IIoT platforms, sensors, and data analytics.
5. To examine the challenges in IIoT deployment, including security and scalability.

Learning Outcome

On successful completion of the course, the students will be able to attain below Learning Outcome (LO):

Learning Outcomes		CL	Linked LO	Teaching Hours
LO1	Interpret the vision of IIoT from a global context.	<i>R, U</i>	1,2,5,6,7,8,9,10	12
LO2	Understand the IIoT Technologies and Communication Protocols	<i>U, A</i>	1,2,4,5,6,8,9,10	12
LO3	Interpretation of Data Acquisition, Processing, and Analytics	<i>R, U</i>	1,2,3,4,5,6,10	06
LO4	Illustration of IIoT Platforms and Implementation	<i>U, A</i>	1,2,5,6,8,9,10	08
LO5	Narration of Security and Future Trends in IIoT	<i>U, A</i>	1,2,5,6,8,9,10	08
LO6	Case Study and Student Activity	<i>U, A</i>	1,2,5,6,7,9,10	14
Total Hours				60

Legends: CL = Cognitive Learning, R = Remember, U= Understand, A= Apply and above levels (Bloom’s Revised Taxonomy)

Learning - LO Attainment Matrix

Learning	Learning Outcomes									
	1	2	3	4	5	6	7	8	9	10
Industrial Internet of Things	3	3	1	2	3	3	2	3	3	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

- Method is to relate the level of LO with the number of hours devoted to the LOs which address the given LO.
- If $\geq 40\%$ of classroom sessions addressing a particular LO, it is considered that LO is addressed at Level 3
- If 25 to 40% of classroom sessions addressing a particular LO, it is considered that LO is addressed at Level 2 If 5 to 25% of classroom sessions addressing a particular LO, it is considered that LO is addressed at Level 1
- If $< 5\%$ of classroom sessions addressing a particular LO, it is considered that LO is considered not-addressed.

Learning Content and Blue Print of Marks for External

Unit No	Unit Name	Hour	Questions to be set for External			Marks Weightage	Marks Weightage (%)
			R	U	A	A	
I	Introduction to Industrial IoT	12	5	20	10	35	24.13
II	IIoT Technologies and Communication Protocols	12	-	20	10	30	20.68
III	Data Acquisition, Processing, and Analytics	06	5	10	-	15	10.35
IV	IIoT Platforms and Implementation	08	-	10	15	25	17.24
V	Security and Future Trends in IIoT	08	-	15	10	25	17.24
VI	Industry Study, Case Study & Student Activity	14	-	15	-	15	10.35
Total		60	10	90	45	145	100

UNIT I: Introduction to Industrial IoT

12 Hrs

IIOOT: Definition, Characteristics of IIoT, Overview of IIoT, Importance of IIOOT, Applications of IIOOT, Physical design of IIoT, Things in IIoT, IIoT Protocols, Logical Design of IIoT, IIoT functional blocks, IIoT communication Models, IIoT communication API's, Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.

IIoT Architecture, IIoT platforms, Benefits of IIoT, Industrial Internet of Things examples, IIoT global market, IIoT Works, IoT vs IIoT.

UNIT II: IIoT Technologies and Communication Protocols

12 Hrs

IIoT Technologies: Introduction, Big Data, Machine Learning, Cloud computing, Wireless communications, Key technologies enabling IIoT, Sensors, Actuators, Sensors and Actuators for Industrial Processes, Sensor networks, Edge Devices.

Communication Protocols: Introduction, MQTT, CoAP, and OPC UA, Industrial networks, Modbus, Profibus, and Ethernet/IP, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.

UNIT III: Data Acquisition, Processing, and Analytics

06 Hrs

Data Acquisition: Introduction, Types, Sensor Data Acquisition, Machine Data Acquisition, Data Acquisition from Industrial Systems.

Data Processing: Definition, Industrial Vs Business Data Processing, Data Processing in Telecom & IT, Data Processing in Industrial Internet of Things (IIoT) Applications, Real-Time Processing of Data for IIoT Applications.

Data Analytics: Overview, Classification, Role of Data Analytics, Applications, Data Analytics vs Big Data Analytics, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

UNIT IV: IIoT Platforms and Implementation

08 Hrs

IIoT Platforms: Introduction, Types of IIoT Platforms, Overview, Azure IoT, AWS IoT, and Siemens MindSphere, IoT Design and Methodology, Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Functional View

Specification.

IloT Implementations: Roadmap to IloT Implementations, Risks, Challenge, IloT implementation in action, Example of IloT implementation, Techniques for integrating hardware and software in IloT systems, study of cloud and edge computing for real-time data processing and decision-making.

UNIT V: Security and Future Trends in IloT

08 Hrs

Security in IloT: Concept, Types, Levels, Data Security, Cyber Security, Industrial IoT Security, IloT Security Hacks, Securing Industrial IoT, Cybersecurity challenges in IloT, IloT Safety and Security Protocol, IloT Security Services, Device Authentication, Data Encryption and Network Security.

Future Trends in IloT: Real-time location systems, Sensor technology, Edge computing, 5G networks, Smarter Inventory Management, Quantum Computing, Digital Twins, and Autonomous Industrial Systems.

UNIT VI: Industry Study, Case Study & Student Activity

14 Hrs

Student Industry Visit - Real-world Case Studies Demonstrating the Applications of IloT – Hands-on Projects and Exercises for Implementation and Practice.

References

1. Industrial Internet of Things: Cybermanufacturing Systems by Sabina eschke, Christian Brecher, Houbing Song, and Danda B. Rawat, Springer, 2017.
2. Industrial IoT: Challenges, Design Principles, Applications, and Security by Ismail Butun, Springer, 2020.
3. Building the Internet of Things by Maciej Kranz, Wiley, 2016.
4. Internet of Things: A Hands-On Approach by Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
5. Smart Sensors for Industrial Internet of Things by Deepak Gupta, Vipin Kumar Jain, and Ashish Khanna, CRC Press, 2021.

Suggested list of student activities

Note: the following activities or similar activities for assessing Internal for 5 marks

1. Each student should do any one of the following type activity or any other similar activity related to the course and before conduction, get it approved from concerned learning coordinator
2. Each student should conduct different activity and no repeating should occur.

1	Understand the overview of IIoT and their importance.
2	Learn and Understand different examples of Industrial Internet of Things.
3	Learn the Deployment steps of any specific IIoT Technologies
4	Learn/Compare Different Hardware Boards for Creating IoT and IIoT Services
5	Understand the different functionalities of sensors in IIoT Devices.
6	Understand Techniques for integrating hardware and software in IIoT systems.
7	Discuss Privacy Issues in IIoT
8	Quiz

Learning Delivery

The learning will be delivered through lectures and Power point presentations / Video

Learning Assessment and Evaluation Scheme

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Learning outcomes
Direct Assessment	External	Internal	Students	Three Internal tests (Average of three tests will be computed)	20	Blue books	1 to 6
				Student activities	10	Report	1 to 6
				Total	30		
	End Semester	End Exam		End of the Learning	70	Answer scripts	1 to 6
Indirect Assessment	Student Feedback on course		Students	Middle of the Learning		Feedback forms	1,2,3 Delivery of course
	End of Learning Survey			End of the Learning		Questionnaires	1 to 6 Effectiveness of Delivery of instructions & Assessment Methods

Note: Internal Evaluation shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Questions for Internal and External will be designed to evaluate the various educational components (Bloom's taxonomy) such as:

Sl. No	Bloom's Category	%
1	Remembrance	07
2	Understanding	62
3	Application	31

Note to Internal verifier: The following documents to be verified by Internal verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 10 marks
3. Student feedback on learning regarding Effectiveness of Delivery of instructions & Assessment Methods.

FORMAT OF INTERNAL TEST QUESTION PAPER

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
			20			
	Year:					
Name of Learning coordinator : Units: _ LO's: _____						
Question No	Question	MARKS	CL	LO	LO	
1						
2						
3						
4						

Note: Internal choice may be given in each LO at the same cognitive level (CL).

Format for Student Activity Assessment

DIMENSION	Unsatisfactory 1	Developing 2	Satisfactory 3	Good 4	Exemplary 5	Score
Collection of data	Does not collect any information relating to the topic	Collects very limited information ; some relate to the topic	Collects some basic information ; refer to the topic	Collects relevant information ; concerned to the topic	Collects a great deal of information; all refer to the topic	3
Fulfill team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties	Performs nearly all duties	Performs all duties	Performs all of assigned team roles with presentation	4

Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Does the assigned job without having to be reminded.	Always does the assigned work having to be reminded and on given time frame	3
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Listens, but sometimes talk too much	Listens and contributes to the relevant topic	Listens and contributes precisely to the relevant topic and exhibit leadership qualities	3
TOTAL						13/4=3.25=4

Note: This is only an example. Appropriate rubrics/criteria may be devised by the concerned Learning Coordinator for assessing the given activity

MODEL QUESTION BANK

Course Title: Industrial Internet of Things

LO	Question	CL	Marks
I	Describe the characteristics of IIoT.	R	05
	Write a Note on IIoT.	A	
	Explain the importance of IIoT.	U	
	Explain IIoT Enabling Technologies.	U	
	Discuss Big Data Analytics role in IIoT.	U	
	Explain Industry 4.0 revolutions.	U	
	Draw a neat diagram and explain, IIoT architecture.	U	
	Describe IIoT platforms.	U	
	Explain benefits of IIoT.	U	
	What is the Role of IIoT in global market?	R	
	Discuss benefits of IIoT.	A	
I	Explain IIoT communication API's.	A	10
	Explain logical design of IIoT.	U	
	Explain the IIoT functional blocks.	U	
	Discuss IoT vs IIoT.	U	
	Discuss things in IIoT.	U	
	Discuss various IIoT technologies.	A	
I	Discuss in detail about big data in IIoT.	A	

II	Explain the concept of cloud computing.	A	05
	Discuss key technologies enabling IIoT.	A	
	Explain the role of IIoT Technologies in healthcare.	A	
	Explain the process automation and data acquisitions on IoT Platform.	U	
	Discuss Applications of wireless sensor networks.	A	10
	Describe the microcontrollers and embedded PC roles in IIoT.	A	
	Explain in detail about IoT hub systems.	U	
	Explain the concept of Wireless Sensor nodes with Bluetooth.	A	
	Discuss applications of communication protocols.	A	
	Discuss in detail about Sensors and Actuators for Industrial Processes.	A	
III	Explain various types of Data Acquisition.	U	5
	What are the Differences between data analytics and big data analytics?	R	
	How do Sensor Data Acquisition is works? Explain.	R	
	What are the differences between data analytics and data analysis?	U	
	Describe Data Processing in Industrial Internet of Things.	U	
	Explain overview of data analytics.	U	
	Explain the Differences between data processing and data preprocessing.	U	
	Explain Real Time Dashboard for Data Monitoring in IIoT.	U	10
Describe Data Analytics and Predictive Maintenance with IIoT technology.	U		
IV	Explain purpose and requirement specification of IoT Design.	U	5
	Describe in detail about Azure IoT.	A	
	Describe the concept of AWS IoT.	A	
	Explain various types of IIoT platforms.	A	
	Explain overview of IIoT platforms.	U	
	Explain various techniques for integrating hardware and software in IIoT systems.	U	10
	Explain in detail about Roadmap to IIoT Implementations.	A	
	Write detail study of cloud and edge computing for real-time data processing and decision-making.	A	
	Explain various security issues in IIoT implementation.	A	
V	What is data security? List Examples.	U	5
	Explain the concepts of cyber security.	A	
	Explain in detail about IIoT security services.	A	
	Differentiate between cyber security and IoT security	U	
	Explain in detail about sensor technology.	U	
	What's the use of edge computing? Explain.	U	10
	With neat Block diagram explain an 5G networks.	A	
	Explain in brief the future trends in IIoT.	U	
	Write a note on use cases and applications of IIoT in different industries.	U	5
	Explain various IIoT applications in various sectors.	U	
	Explain IIoT applications in retail and supply chain.	A	

VI	List and explain IIoT applications in smart agriculture.	A	
	Write a brief Case Study on IIoT in cybersecurity.	U	
	Write a detail case study on challenges and solutions for IIoT applications.	U	
	Write a brief Case Study on application of IIoT.	U	10
	Describe a detail case study on IOT applications for industry.	A	