ROHINI
COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
Approved By AICTE & Affiliated to Anna University
NBA Accredited for All Eligible B.E/B.Tech Programs | NAAC Accredited with A+ Grade
Near Anjugramam - Kanyakumari Main Road, Palkulam, Variyoor P.O.-629401, Kanyakumari Dist, Tamil Nadu.

MINOR COURSE

Internet of Things (IoT)

Curriculum & Syllabus

(*2024-2025 Admitted Students Onwards*)

CREDIT INFO		
Sl.No	**Category**	**Credits**
1	**Minor Courses**	**18**

CREDIT DISTRIBUTION

Sl. No.	**Course Category**	**Credit/Semester**								**No. of Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	MCC	**-**	**-**	**-**	**-**	**6**	**6**	**6**	**-**	**18**

Internet of Things (IoT)							
S. No.	Course Code	Course Title	Course Category	L	T	P	C
1	24IT501	Fundamentals Of Internet of Things	MCC	3	0	0	3
2	24IT502	IoT Sensors, Devices and Edge Computing	MCC	3	0	0	3
3	24IT601	IoT Communication, Cloud and Data Analytics	MCC	3	0	0	3
4	24IT602	Industrial Internet of Things and Smart Systems	MCC	3	0	0	3
5	24IT701	AIoT, Digital Twins and Intelligent Automation	MCC	3	0	0	3
6	24IT702	IoT Capstone Project and Industry Applications	MCC	0	0	6	3

Course Code:	24IT501	Course Title:	FUNDAMENTALS OF INTERNET OF THINGS
Credits:	3	L – T – P	3-0-0
Pre-requisite			24EE404-IOT-SENSORS AND DEVICES

Course objectives:

The course enables the students to:

1. Understand the concepts, architecture, components, and enabling technologies of the Internet of Things (IoT) for smart engineering systems.
2. Apply IoT sensors, actuators, communication technologies, and cloud platforms to acquire, monitor, and manage real-time data.
3. Analyze IoT architectures, communication models, data flow, and interoperability for connected devices and smart applications.
4. Explore IoT solutions for smart manufacturing, healthcare, agriculture, energy, transportation, environmental monitoring, and smart cities.
5. Design basic IoT-based solutions using appropriate hardware, software platforms, and cloud services to solve real-world engineering problems.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

- Interactive Lectures with Industry Case Studies
- Demonstration of IoT Hardware and Sensors
- Hands-on Sessions using Arduino/ESP32 Platforms
- Problem-Based Learning
- Project-Based Learning
- Flipped Classroom
- Collaborative Learning
- Simulation and Cloud-Based IoT Demonstrations
- Mini Projects
- Technical Seminars

UNIT I – INTRODUCTION TO INTERNET OF THINGS AND SMART CONNECTED SYSTEMS	[9 hours]
Evolution of Internet of Things – Characteristics of IoT – IoT Ecosystem – IoT Architecture – Physical, Network, Edge, Cloud, and Application Layers – Enabling Technologies – Cyber-Physical Systems – Smart Connected Products – IoT Standards – IoT Platforms – Applications in Industry 4.0 and Smart Engineering Systems.	
UNIT II – IoT DEVICES, SENSORS AND DATA ACQUISITION	**[9 hours]**
IoT Devices – Smart Sensors – Actuators – Sensor Characteristics – Data Acquisition Systems – Analog and Digital Sensors – Sensor Interfacing Concepts – RFID – NFC – GPS – Environmental Sensors – Industrial Sensors – Wearable Devices – Energy-Efficient IoT Devices – Device Management.	
UNIT III – IoT COMMUNICATION, NETWORKING AND CLOUD PLATFORMS	**[9 hours]**
IoT Communication Models – MQTT – CoAP – HTTP – REST APIs – Wi-Fi – Bluetooth Low Energy (BLE) – ZigBee – LoRaWAN – NB-IoT (Concepts) – Edge Computing Fundamentals – Cloud Computing for IoT – IoT Cloud Platforms – Data Storage – Device Connectivity – Real-Time Data Streaming.	
UNIT IV – IoT DATA MANAGEMENT, SECURITY AND ANALYTICS	**[9 hours]**
IoT Data Lifecycle – Data Collection – Data Processing – Data Visualization – Dashboards – Cloud Analytics – Introduction to AI-enabled IoT (AIoT) – IoT Security Fundamentals – Authentication – Access Control – Secure Communication – Privacy Issues – Blockchain Concepts for IoT – Digital Twin Fundamentals.	
UNIT V – IoT APPLICATIONS IN SMART ENGINEERING SYSTEMS	**[9 hours]**
Industrial Internet of Things (IIoT) – Smart Manufacturing – Predictive Maintenance – Smart Grid – Smart Agriculture – Smart Healthcare – Smart Buildings – Intelligent Transportation Systems – Environmental Monitoring – Water Resource Management – Smart Energy Systems – Smart Cities – Future Trends in IoT and Industry 5.0.	

Total Period:45

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain the architecture, components, communication models, and enabling technologies of Internet of Things systems.	K2
CO2	Apply IoT sensors, actuators, communication technologies, and cloud platforms for data acquisition and monitoring	K3
CO3	Analyze IoT system architecture, device connectivity, and data flow for smart engineering applications.	K4
CO4	Evaluate IoT solutions for industrial automation, healthcare, agriculture, smart buildings, transportation, and environmental monitoring	K5
CO5	Design basic IoT applications integrating sensing, communication, cloud computing, and data visualization for engineering systems	K3

COs and POs Mapping:

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO5	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max	Reduced	Total	Final
		Marks	Marks		marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	10	10
Understand	80	30	30
Apply	0	40	40
Analyze	0	20	20
Evaluate	0	0	0
Create	0	0	0

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, Internet of Things – A Hands-on Approach, Universities Press, Latest Edition.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press, Latest Edition.
3. Raj Kamal, Internet of Things: Architecture and Design Principles, 3rd Edition, McGraw-Hill Education.

Reference Books:

1. Olivier Hersent, David Boswarthick, and Omar Elloumi, The Internet of Things: Key Applications and Protocols, 3rd Edition, Wiley.
2. Samuel Greengard, The Internet of Things, MIT Press.
3. Srinivasa K. G., Internet of Things, Cengage Learning.
4. Arshdeep Bahga and Vijay Madisetti, Cloud Computing: A Hands-on Approach, Universities Press.
5. Fei Tao and Qinglin Qi, Digital Twin Driven Smart Manufacturing, Academic Press

WebLinks and Video Lectures (E-Resources):

1. Evolution of Internet of Things: https://www.youtube.com/watch?v=DLH9p4vyvuM
2. Sensor Characteristics – Data Acquisition Systems https://www.youtube.com/watch?v=3L8oxUxaXd4
3. IoT Communication Models: https://www.youtube.com/watch?v=48TpRSgyEPE
4. IoT Data Lifecycle :https://www.youtube.com/watch?v=fyqQGubspos
5. Smart Manufacturing :https://www.youtube.com/watch?v=1vLc2FOU04Y

Online Courses:

1. https://nptel.ac.in/courses/106105166
2. https://nptel.ac.in/courses/108108098

Suggested Skill Activities:

Students shall complete the following laboratory and skill-oriented activities.

1. Identify and interface different IoT sensors for data acquisition.
2. Develop a simple sensor monitoring application using Arduino or ESP32.
3. Connect an IoT device to a cloud platform for real-time monitoring.
4. Publish and subscribe sensor data using MQTT protocol.

5. Create a cloud dashboard for IoT data visualization.
6. Analyze sensor data for engineering decision-making.
7. Demonstrate an IoT application for smart agriculture or environmental monitoring.
8. Develop a basic IoT solution for smart energy or smart building applications.
9. Prepare a case study on Industrial IoT or Smart Cities.
10. Design a mini project addressing a real-world engineering problem using IoT technologies.

Course Code:	24IT502	Course Title:	IoT SENSORS, DEVICES AND EDGE COMPUTING
Credits:	3	L – T – P	3-0-0
Pre-requisite			24IT501-FUNDAMENTALS OF INTERNET OF THINGS

Course objectives:

The course enables the students to:

1. Understand the principles of IoT sensors, actuators, embedded devices, and edge computing technologies used in smart engineering systems.
2. Apply sensor interfacing, data acquisition, embedded platforms, and edge computing techniques for real-time IoT applications.
3. Analyze the performance, connectivity, and energy efficiency of IoT devices and edge-enabled systems.
4. Evaluate edge computing frameworks, device management, and intelligent edge analytics for Industrial IoT (IIoT) applications.
5. Design IoT edge solutions integrating sensors, embedded devices, communication protocols, and cloud services to address real-world engineering challenges.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

- Interactive Lectures with Industry Case Studies
- Hands-on Laboratory Sessions using ESP32/Arduino/Raspberry Pi
- Demonstration of IoT Sensors and Embedded Devices
- Edge Computing Experiments
- Problem-Based Learning
- Project-Based Learning
- Flipped Classroom
- Collaborative Learning
- Mini Projects and Technical Seminars
- Industry Expert Talks

UNIT I - IoT DEVICES, EMBEDDED PLATFORMS AND SYSTEM ARCHITECTURE	[9 hours]
Introduction to Embedded IoT Devices – IoT Device Architecture – Microcontrollers and Single Board Computers – Arduino, ESP32, Raspberry Pi – Device Interfaces – GPIO, ADC, DAC, PWM – Embedded Operating Systems – Real-Time Operating Systems (RTOS) Concepts – Device Boot Process – Power Management – IoT Device Selection – Applications in Smart Engineering Systems.	
UNIT II – SMART SENSORS, ACTUATORS AND DATA ACQUISITION	**[9 hours]**
Sensor Fundamentals – Sensor Characteristics – Temperature, Humidity, Pressure, Light, Proximity, Motion, Gas, Vibration and Position Sensors – MEMS Sensors – Industrial Sensors – Biomedical Sensors – Smart Actuators – Signal Conditioning – Analog-to-Digital Conversion – Sensor Calibration – Data Acquisition Systems – Sensor Fusion – RFID, NFC and GPS Fundamentals.	
UNIT III – IoT DEVICE CONNECTIVITY AND EDGE PROCESSING	**[9 hours]**
Device Connectivity – Serial Communication (UART, SPI, I^2C) – Wireless Communication Interfaces – Wi-Fi, Bluetooth Low Energy (BLE), ZigBee, LoRaWAN and NB-IoT (Concepts) – Edge Devices – Data Filtering – Local Processing – Edge Intelligence – Device-to-Device Communication – Energy-Efficient Communication – Edge Gateway Architecture.	
UNIT IV – EDGE COMPUTING AND INTELLIGENT IoT SYSTEMS	**[9 hours]**
Fundamentals of Edge Computing – Edge vs Fog vs Cloud Computing – Edge Analytics – Artificial Intelligence at the Edge (Edge AI) – TinyML Concepts – Real-Time Decision Making – Edge Security Fundamentals – Containerization Concepts – Device Management – Remote Monitoring – Firmware Updates (OTA) – Resource Optimization – Industrial Edge Computing Applications.	
UNIT V – IoT SENSORS, EDGE COMPUTING AND SMART ENGINEERING APPLICATIONS	**[9 hours]**
Industrial Internet of Things (IIoT) Devices – Smart Manufacturing – Predictive Maintenance – Smart Agriculture – Precision Farming – Healthcare Monitoring – Wearable Devices – Smart Buildings – Smart Grid Monitoring – Intelligent Transportation Systems – Environmental Monitoring – Renewable Energy Systems – Digital Twin Data Acquisition – Future Trends in Edge Computing and Intelligent IoT.	

Total Period:45

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain the architecture, characteristics, and operation of IoT sensors, actuators, embedded devices, and edge computing systems	K2
CO2	Apply sensor interfacing, embedded platforms, and edge computing technologies for real-time data acquisition and processing.	K3
CO3	Analyze IoT device performance, communication, power management, and edge analytics for smart engineering applications	K4
CO4	Evaluate edge-enabled IoT solutions for smart manufacturing, healthcare, agriculture, transportation, and energy systems	K5
CO5	Design energy-efficient IoT systems integrating sensors, edge devices, communication technologies, and cloud platforms for industrial applications	K3

COs and POs Mapping:

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO5	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
	CIE – I	100			
Continuous Internal Examination (CIE)	CIE – II	100	50	100	40
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	10	10
Understand	80	30	30
Apply	0	40	40
Analyze	0	20	20
Evaluate	0	0	0
Create	0	0	0

TEXT BOOKS

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press, Latest Edition.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, IoT

Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press, Latest Edition.

3. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed, Wiley, Latest Edition.

REFERENCE BOOKS

1. Raj Kamal, Internet of Things: Architecture and Design Principles, 3rd Edition, McGraw-Hill Education.
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, The Internet of Things: Key Applications and Protocols, 3rd Edition, Wiley.
3. Michael J. Pont, Embedded C Programming and the Microcontroller, CRC Press.
4. Shyam Varan Nath, Pethuru Raj, Anupama Raman, and Sanjeev Chatterjee, Internet of Things and Edge Computing for Smart Systems, Springer.
5. Fei Tao and Qinglin Qi, Digital Twin Driven Smart Manufacturing, Academic Press

WebLinks and Video Lectures (E-Resources):

1. Raspberry Pi- https://www.youtube.com/watch?v=3zEzh5-f4KA
2. Sensor Fundamentals - https://www.youtube.com/watch?v=XI49uFm5HRE
3. Device Connectivity- https://www.youtube.com/watch?v=eMamgWllRFY
4. Fundamentals of Edge Computing -https://www.youtube.com/watch?v=m4ScX1oEJzA
5. Industrial Internet of Things (IIoT) Devices- https://www.youtube.com/watch?v=HmbUJEShA-8

Online Courses:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs38
2. https://nptel.ac.in/courses/106105166

Suggested Skill Activities:

Students shall complete the following laboratory and skill-oriented activities.

1. Interface temperature, humidity, and motion sensors with an ESP32 or Arduino board.
2. Acquire and visualize real-time sensor data using serial monitoring tools.
3. Develop an IoT application integrating multiple sensors and actuators.
4. Configure wireless communication between IoT devices using Wi-Fi or BLE.
5. Implement local edge data filtering and threshold-based decision-making.

6. Perform sensor calibration and analyze measurement accuracy.
7. Demonstrate edge-based monitoring for smart agriculture or industrial equipment.
8. Configure remote monitoring and over-the-air (OTA) firmware update concepts.
9. Design an energy-efficient IoT edge architecture for a smart engineering application.
10. Develop a mini project using sensors, embedded devices, and edge computing for industrial or societal applications.

Course Code:	24IT601	Course Title:	IoT COMMUNICATION, CLOUD AND DATA ANALYTICS
Credits:	3	L – T – P	3-0-0
Pre-requisite			24IT502-IOT SENSORS, DEVICES AND EDGE COMPUTING

Course objectives:

The course enables the students to:

1. Understand IoT communication architectures, networking technologies, cloud platforms, and data analytics techniques for connected engineering systems.
2. Apply IoT communication protocols, cloud services, and data management techniques to collect, transmit, store, and process real-time IoT data.
3. Analyze cloud-enabled IoT architectures, edge-cloud integration, and streaming analytics for intelligent decision-making.
4. Evaluate cloud computing platforms, data visualization tools, and security mechanisms for scalable IoT deployments.
5. Design cloud-based IoT solutions integrating communication networks, analytics, dashboards, and AI-assisted services for smart engineering applications.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

- Interactive Lectures with Industry Case Studies
- Hands-on Laboratory Sessions using MQTT, Node-RED, and Things Board
- Cloud-Based IoT Experiments
- Demonstration of AWS IoT, Azure IoT, and Google Cloud IoT Services
- Problem-Based Learning
- Project-Based Learning
- Flipped Classroom
- Collaborative Learning
- Data Analytics Workshops

- Mini Projects and Technical Seminars

UNIT I - IoT COMMUNICATION ARCHITECTURE AND NETWORKING	[9 hours]
IoT Communication Architecture – Device-to-Device, Device-to-Cloud, Cloud-to-Cloud, and Device-to-Gateway Communication Models – IoT Network Architecture – IPv6 for IoT – MQTT – CoAP – HTTP/HTTPS – REST APIs – AMQP Concepts – Web Sockets – Message Brokers – Quality of Service (QoS) – Engineering Applications of IoT Communication.	
UNIT II – WIRELESS IoT NETWORKS AND EDGE-CLOUD CONNECTIVITY	**[9 hours]**
Wireless Communication Technologies – Wi-Fi – Bluetooth Low Energy (BLE) – ZigBee – Thread – LoRaWAN – Sigfox – NB-IoT – LTE-M – 5G IoT Concepts – Edge Computing – Fog Computing – Edge-to-Cloud Integration – Gateway Architecture – Device Provisioning – Network Performance and Reliability.	
UNIT III - CLOUD COMPUTING FOR IoT	**[9 hours]**
Cloud Computing Fundamentals – IoT Cloud Architecture – Infrastructure as a Service (IaaS) – Platform as a Service (PaaS) – Software as a Service (SaaS) – AWS IoT Core – Microsoft Azure IoT Hub – Google Cloud IoT Concepts – ThingSpeak – Blynk – Node-RED – ThingsBoard – Data Storage – Time-Series Databases – Cloud Security Fundamentals.	
UNIT IV – IoT DATA ANALYTICS AND VISUALIZATION	**[9 hours]**
IoT Data Lifecycle – Real-Time Data Streaming – Data Preprocessing – Data Cleaning – Data Aggregation – Time-Series Analytics – Predictive Analytics Fundamentals – AI-Assisted IoT Analytics – Dashboard Design – Grafana – Power BI Concepts – Data Visualization – Event Processing – Alert Generation – Decision Support Systems	
UNIT V – CLOUD-BASED IoT APPLICATIONS IN SMART ENGINEERING SYSTEMS	**[9 hours]**
. Industrial IoT Cloud Platforms – Smart Manufacturing – Remote Equipment Monitoring – Predictive Maintenance – Smart Healthcare – Smart Agriculture – Smart Grid – Intelligent Transportation Systems – Environmental Monitoring – Smart Buildings – Digital Twin Data Management – Cloud Security and Privacy – Sustainable IoT Solutions – Future Trends in Cloud-Native IoT and AIoT.	

Total Period:45

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain IoT communication architectures, networking protocols, cloud computing concepts, and data analytics workflows for connected systems.	K2
CO2	Apply IoT communication protocols, cloud platforms, and data storage services to develop real-time IoT applications	K3
CO3	Analyze IoT data streams using cloud analytics, visualization tools, and edge-cloud integration techniques.	K4
CO4	Evaluate secure, scalable, and reliable cloud-enabled IoT solutions for industrial and smart engineering applications.	K5
CO5	Design cloud-based IoT systems integrating communication networks, real-time analytics, dashboards, and AI-assisted decision support	K3

COs and POs Mapping:

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO5	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
	CIE – I	100			
Continuous Internal Examination (CIE)	CIE – II	100	50	100	40
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	10	10
Understand	80	30	30
Apply	0	40	40
Analyze	0	10	10
Evaluate	0	10	10
Create	0	0	0

TEXT BOOKS

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press, Latest Edition.
2. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities

Press, Latest Edition.

3. Raj Kamal, Internet of Things: Architecture and Design Principles, 3rd Edition, McGraw-Hill Education.

REFERENCE BOOKS

1. Olivier Hersent, David Boswarthick, and Omar Elloumi, The Internet of Things: Key Applications and Protocols, 3rd Edition, Wiley.
2. Perry Lea, Internet of Things for Architects, Packt Publishing.
3. Pethuru Raj and Anupama Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
4. Fei Tao and Qinglin Qi, Digital Twin Driven Smart Manufacturing, Academic Press.
5. Kai Hwang, Geoffrey Fox, and Jack Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann.

WebLinks and Video Lectures (E-Resources):

1. IoT Communication Architecture- https://www.youtube.com/watch?v=KeaeuUcw02Q&t=81s
2. Wireless Communication Technologies- https://www.youtube.com/watch?v=UlgRhEYu17w
3. Cloud Computing Fundamentals -https://www.youtube.com/watch?v=uroryFU78gM

Online Courses:

1. https://nptel.ac.in/courses/108108179
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs53

Suggested Skill Activities:

Students shall complete the following laboratory and skill-oriented activities.

1. Configure MQTT communication between IoT devices and a cloud platform.
2. Develop a Node-RED flow for real-time sensor data acquisition and processing.
3. Connect an ESP32/Arduino device to a cloud IoT platform such as ThingSpeak or ThingsBoard.
4. Create dashboards for real-time IoT monitoring and visualization.
5. Implement REST API-based communication between IoT devices and cloud services.
6. Analyze time-series sensor data and generate meaningful insights.
7. Configure alert notifications for abnormal sensor readings.

8. Evaluate cloud service performance for an IoT application.
9. Design a cloud-based IoT architecture for a smart engineering application.
10. Develop a mini project integrating IoT communication, cloud services, analytics, and visualization.

Course Code:	24IT602	Course Title:	INDUSTRIAL INTERNET OF THINGS AND SMART SYSTEM
Credits:	3	L – T – P	3-0-0
Pre-requisite			24IT601-IOT COMMUNICATION, CLOUD AND DATA ANALYTICS

Course objectives:

The course enables the students to:

1. Understand the architecture, components, and enabling technologies of the Industrial Internet of Things (IIoT) and smart engineering systems.
2. Apply IIoT technologies, industrial communication networks, sensors, cloud platforms, and edge computing for industrial automation and monitoring.
3. Analyze industrial processes using real-time data acquisition, predictive maintenance, and intelligent monitoring techniques.
4. Evaluate smart manufacturing, cyber-physical systems, digital factories, and Industry 4.0 technologies for improving industrial productivity and sustainability.
5. Design IIoT-based smart engineering solutions integrating industrial automation, AI, Digital Twins, and cloud technologies for real-world applications

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

- Interactive Lectures with Industry Case Studies
- Hands-on Demonstrations of Industrial IoT Platforms
- Simulation-Based Learning
- Problem-Based Learning
- Project-Based Learning
- Flipped Classroom
- Collaborative Learning
- Industrial Visits and Expert Talks
- Mini Projects and Technical Seminars

- Case Study Analysis of Smart Factories

UNIT I - INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS AND SMART SYSTEMS	[9 hours]
Evolution of Industrial Automation – Industrial Internet of Things (IIoT) – Industry 4.0 and Industry 5.0 – Smart Factories – Cyber-Physical Systems (CPS) – Intelligent Manufacturing – IIoT Architecture – Industrial Digital Transformation – Industrial Data Lifecycle – Smart Engineering Systems – Applications of IIoT in Modern Industries	
UNIT II – INDUSTRIAL SENSORS, COMMUNICATION AND AUTOMATION	**[9 hours]**
Industrial Sensors and Actuators – Smart Instrumentation – Programmable Logic Controllers (PLC) Concepts – Supervisory Control and Data Acquisition (SCADA) Concepts – Distributed Control Systems (DCS) – Industrial Communication Networks – Modbus – CAN Bus – OPC UA – PROFINET (Concepts) – Industrial Gateways – Real-Time Monitoring – Edge Devices in IIoT.	
UNIT III – IIoT DATA MANAGEMENT, CLOUD AND PREDICTIVE ANALYTICS	**[9 hours]**
Industrial Data Acquisition – Edge Computing – Cloud Computing for IIoT – Industrial IoT Platforms – Data Integration – Time-Series Databases – Industrial Dashboards – Predictive Maintenance – Condition Monitoring – AI-Assisted Industrial Analytics – Machine Learning for Industrial Data – Process Optimization – Asset Performance Management.	
UNIT IV – SMART ENGINEERING SYSTEMS AND DIGITAL TRANSFORMATION	**[9 hours]**
Smart Manufacturing – Digital Factory – Robotics and Automation – Smart Grid – Intelligent Energy Management – Smart Agriculture – Smart Healthcare – Smart Buildings – Intelligent Transportation Systems – Supply Chain Digitization – Digital Twins in Industry – Sustainable Manufacturing – Industrial Cybersecurity Fundamentals.	
UNIT V – IIoT APPLICATIONS, SECURITY AND FUTURE TRENDS	**[9 hours]**
Industrial IoT Security Principles – Secure Industrial Communication – Zero Trust Concepts – Risk Assessment – Industrial Standards and Compliance – AIoT in Industrial Automation – Collaborative Robots (Cobots) – Industrial Metaverse – Green Manufacturing – Circular Economy – Human-Centric Industry 5.0 – Emerging Trends in IIoT – Engineering Case Studies.	

Total Period:45

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain the architecture, components, and enabling technologies of Industrial Internet of Things (IIoT) and smart engineering systems.	K2
CO2	Apply industrial communication technologies, sensors, cloud platforms, and edge computing for industrial automation and monitoring	K3
CO3	Analyze industrial processes using IIoT data, predictive maintenance techniques, and intelligent analytics	K4
CO4	Evaluate Industry 4.0 and smart engineering solutions for manufacturing, energy, healthcare, transportation, and critical infrastructure	K5
CO5	Design secure and intelligent IIoT systems integrating automation, AI, Digital Twins, and cloud computing for industrial applications	K3

COs and POs Mapping:

COs	POs											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**
CO5	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	10	10
Understand	80	30	30
Apply	0	40	40
Analyze	0	20	20
Evaluate	0	0	0
Create	0	0	0

TEXT BOOKS

1. Alasdair Gilchrist, **Industry 4.0: The Industrial Internet of Things**, 2nd Edition, Apress.
2. Fei Tao and Ang Liu, **Digital Twin Driven Smart Manufacturing**, Academic Press.
3. Sabina Jeschke, Christian Brecher, Houbing Song, and Danda B. Rawat (Eds.), **Industrial Internet of Things: Cybermanufacturing Systems**, Springer.

REFERENCE BOOKS

1. John Soldatos, **Industrial Internet of Things (IIoT): Technologies, Applications and Challenges**, River Publishers.
2. Pethuru Raj and Anupama Raman, **The Internet of Things: Enabling Technologies, Platforms and Use Cases**, CRC Press.
3. Raj Kamal, **Internet of Things: Architecture and Design Principles**, McGraw-Hill Education.
4. Fei Tao and Qinglin Qi, **Digital Twin Driven Smart Manufacturing**, Academic Press.
5. Lihui Wang and Robert Gao, **Cloud-Based Cyber-Physical Systems in Manufacturing**, Springer.

WebLinks and Video Lectures (E-Resources):

1. IoT Architecture Stack: https://www.youtube.com/watch?v=7moRdkJQSb0
2. Designing Next Generation Industrial IoT Architecture: https://www.youtube.com/watch?v=TXzACi8Rsj4
3. Industrial Data Acquisition: https://www.youtube.com/watch?v=lfuJ6cLIfZ0
4. Cloud Computing for IIoT: https://www.youtube.com/watch?v=M988_fsOSWo
5. Industrial IoT Security Principles: https://www.youtube.com/watch?v=6fdpm3IYm_A

Online Courses:

1. **https://nptel.ac.in/courses/106105195**
2. https://nptel.ac.in/courses/106105166

Suggested Skill Activities:

Students shall complete the following laboratory and skill-oriented activities.

1. Design a basic IIoT architecture for a smart manufacturing system.
2. Interface industrial sensors for process monitoring and data acquisition.

3. Simulate industrial communication using Modbus or OPC UA concepts.
4. Develop a real-time industrial monitoring dashboard using an IoT platform.
5. Analyze industrial sensor data for predictive maintenance.
6. Design an edge-enabled monitoring solution for industrial equipment.
7. Evaluate an Industry 4.0 case study on smart factory implementation.
8. Develop a conceptual Digital Twin for an industrial process.
9. Assess cybersecurity risks in an IIoT deployment and recommend mitigation measures.
10. Develop a mini project integrating IIoT technologies for smart manufacturing, energy, healthcare, agriculture, or transportation.

Course Code:	**24IT 701**	**Course Title:**	**AIoT, DIGITAL TWINS AND INTELLIGENT AUTOMATION**
Credits:	**3**	**L – T – P**	**3-0-0**
Pre-requisite			**24IT 602-IOT COMMUNICATION, CLOUD AND DATA ANALYTICS**

Course objectives:

The course enables the students to:

1. Understand the concepts, architecture, and enabling technologies of Artificial Intelligence of Things (AIoT), Digital Twins, and Intelligent Automation for smart engineering systems.
2. Apply artificial intelligence, machine learning, edge AI, and Digital Twin technologies to develop intelligent IoT-based solutions.
3. Analyze IoT data using AI models, predictive analytics, and real-time decision-making techniques for industrial automation.
4. Evaluate intelligent automation systems integrating AIoT, robotics, cloud computing, and Digital Twins for Industry 4.0 and Industry 5.0 applications.
5. Design AI-enabled IoT solutions for smart manufacturing, healthcare, agriculture, transportation, energy, and sustainable engineering systems

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

- Interactive Lectures with Industry Case Studies
- Hands-on Sessions using AIoT and Cloud Platforms
- Demonstration of Digital Twin Technologies
- Problem-Based Learning
- Project-Based Learning
- Flipped Classroom
- Collaborative Learning

- Simulation-Based Learning
- Mini Projects and Technical Seminars
- Industry Expert Talks

UNIT I - INTRODUCTION TO AIoT, DIGITAL TWINS AND INTELLIGENT AUTOMATION	**[9 hours]**
Evolution of Artificial Intelligence of Things (AIoT) – AIoT Architecture – Integration of AI and IoT – Industry 4.0 and Industry 5.0 – Intelligent Automation – Digital Twin Fundamentals – Digital Thread – Cyber-Physical Systems (CPS) – Smart Connected Systems – Applications in Engineering and Industry.	
UNIT II – AI, EDGE INTELLIGENCE AND DIGITAL TWIN TECHNOLOGIES	**[9 hours]**
Machine Learning Fundamentals for IoT – Supervised and Unsupervised Learning Concepts – Edge AI – TinyML Fundamentals – AI Model Deployment on Edge Devices – Computer Vision for IoT – Natural Language Processing Concepts – Digital Twin Architecture – Real-Time Synchronization – Simulation Models – Virtual Commissioning – Intelligent Monitoring	
UNIT III – PREDICTIVE ANALYTICS AND INTELLIGENT AUTOMATION	**[9 hours]**
IoT Data Analytics – Predictive Maintenance – Condition Monitoring – Time-Series Data Analysis – AI-Based Fault Detection – Intelligent Decision Support Systems – Process Optimization – Autonomous Monitoring – Intelligent Scheduling – Industrial Robotics Concepts – Collaborative Robots (Cobots) – AI-Driven Process Automation	
UNIT IV – AIoT AND DIGITAL TWIN APPLICATIONS IN SMART ENGINEERING SYSTEMS	**[9 hours]**
Smart Manufacturing – Digital Factory – Smart Grid – Renewable Energy Systems – Smart Agriculture – Precision Farming – Healthcare and Remote Patient Monitoring – Intelligent Transportation Systems – Smart Buildings – Environmental Monitoring – Supply Chain Optimization – Smart Cities – Sustainable Engineering Solutions	
UNIT V – EMERGING TRENDS, ETHICS AND FUTURE INTELLIGENT SYSTEMS	**[9 hours]**
Generative AI for IoT – Explainable AI (XAI) Concepts – Industrial Metaverse – Human-Centric Industry 5.0 – Cloud Robotics – Autonomous Systems – Green AI – Sustainable Intelligent Automation – AI Governance – Privacy and Security in AIoT – Ethical AI – Future Trends in AIoT and Digital Twin Technologies – Engineering Case Studies.	

Total Period:45

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Explain the concepts, architecture, and enabling technologies of AIoT, Digital Twins, and Intelligent Automation	K2
CO2	Apply AI, machine learning, edge intelligence, and Digital Twin technologies for developing intelligent IoT systems	K3
CO3	Analyze real-time IoT data using predictive analytics, AI models, and Digital Twin simulations for engineering applications	K4
CO4	Evaluate AIoT-enabled automation solutions for smart manufacturing, healthcare, transportation, agriculture, and energy systems	K5
CO5	Evaluate AIoT-enabled automation solutions for smart manufacturing, healthcare, transportation, agriculture, and energy systems	K3

COs and POs Mapping:

COs	POs										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**3**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**
CO4	**2**	**2**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**2**
CO5	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
Total					100

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	10	10
Understand	80	30	30
Apply	0	40	40
Analyze	0	20	20
Evaluate	0	0	0
Create	0	0	0

TEXT BOOKS

1. Fei Tao and Ang Liu, Digital Twin Driven Smart Manufacturing, Academic Press, 2023.
2. Rajkumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Morgan Kaufmann.

3. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 2nd Edition, Apress.

REFERENCE BOOKS

1. Michael Grieves and John Vickers, Digital Twin: Mitigating Unpredictable, Undesirable Emergent Behavior in Complex Systems, Springer.
2. John Soldatos, Building the Industrial Metaverse, Springer, 2024.
3. Pethuru Raj and Anupama Raman, The Internet of Things: Enabling Technologies, Platforms and Use Cases, CRC Press.
4. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson.
5. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press.

WebLinks and Video Lectures (E-Resources):

6. Introduction To AIoT, Digital Twins and Intelligent Automation https://www.youtube.com/watch?v=szdkTaCFVOk
7. AI, edge intelligence and digital twin technologies - https://www.youtube.com/watch?v=lGA_Lto9UfI
8. AIoT and digital twin applications in smart engineering systems- https://www.youtube.com/watch?v=NMiwvU0Waw0
1. Generative AI for IoT- https://www.youtube.com/watch?v=NRmAXDWJVnU
2. Design an AI-enabled intelligent automation solution for a smart engineering application- https://www.youtube.com/watch?v=5TxSqvPbnWw

Online Courses:

1. https://nptel.ac.in/courses/127101872
2. http://www.digimat.in/nptel/courses/video/105106213/L68.html

Suggested Skill Activities:

Students shall complete the following laboratory and skill-oriented activities.

1. Develop a simple AI model for IoT sensor data classification or prediction.
2. Deploy an edge AI application using TinyML or TensorFlow Lite concepts.

3. Design a Digital Twin architecture for an industrial or smart engineering system.
4. Analyze sensor data for predictive maintenance using machine learning techniques.
5. Develop an intelligent dashboard for AI-assisted decision-making.
6. Demonstrate an AIoT application for smart agriculture, healthcare, or energy management.
7. Implement anomaly detection using IoT sensor datasets.
8. Evaluate an Industrial Metaverse or Digital Twin case study.
9. Design an AI-enabled intelligent automation solution for a smart engineering application.
10. Develop a mini project integrating AIoT, Digital Twins, cloud computing, and intelligent automation.

Course Code:	24IT702	Course Title:	IoT CAPSTONE PROJECT AND INDUSTRY APPLICATIONS
Credits:	3	L – T – P	0-0-6
Pre-requisite			24IT701-AIOT, DIGITAL TWINS AND INTELLIGENT AUTOMATION

Course objectives:

The course enables the students to:

1. Integrate the knowledge of IoT, AIoT, cloud computing, edge computing, Digital Twins, and intelligent automation to develop industry-oriented engineering solutions.
2. Apply engineering design principles, project management methodologies, and modern IoT development tools to solve real-world industrial and societal problems.
3. Analyze user requirements, technical feasibility, system performance, and sustainability aspects while developing IoT-based smart systems.
4. Develop and deploy secure, scalable, and intelligent IoT applications using sensors, communication technologies, cloud platforms, AI models, and data analytics.
5. Demonstrate professional, ethical, teamwork, entrepreneurship, and lifelong learning skills through the successful completion and presentation of an industry-relevant IoT project.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

- Design Thinking Workshops
- Industry Mentoring Sessions
- Agile Development Methodology
- Collaborative Team Learning
- Hands-on Development using IoT Hardware and Cloud Platforms
- Simulation and Prototype Development
- Project Demonstrations
- Viva Voce and Technical Presentations

UNIT I - PROJECT IDENTIFICATION, REQUIREMENT ANALYSIS AND PLANNING	[9 hours]
Engineering Problem Identification – Industry and Societal Challenges – Design Thinking – User Requirement Analysis – Functional and Non-Functional Requirements – Feasibility Study – Technology Selection – Literature Survey – Software Requirement Specification (SRS) – Project Planning – Agile Development Concepts – Risk Assessment – Project Scheduling.	
UNIT II – SYSTEM DESIGN AND PROTOTYPE DEVELOPMENT	**[9 hours]**
IoT System Architecture Design – Sensor and Device Selection – Embedded Hardware Integration – Communication Network Design – Edge and Cloud Architecture – Database Design – Dashboard Planning – User Interface Design – Security Considerations – Digital Twin Integration – Prototype Development – Design Validation.	
UNIT III – IMPLEMENTATION, AI INTEGRATION AND TESTING	**[9 hours]**
Embedded Programming – Cloud Platform Integration – MQTT/HTTP Communication – AI Model Integration – Edge Analytics – Data Visualization – Alert Generation – Functional Testing – Performance Optimization – Reliability Testing – Security Testing – Documentation of System Development.	
UNIT IV – DEPLOYMENT, PERFORMANCE EVALUATION AND ENTREPRENEURSHIP	**[9 hours]**
Deployment on Cloud and Edge Platforms – Device Provisioning – Performance Evaluation – Scalability Assessment – Energy Efficiency Analysis – User Acceptance Testing – Technical Documentation – Intellectual Property Rights (IPR) – Startup Opportunities – Product Commercialization – Sustainable Engineering Practices.	
UNIT V – INDUSTRY APPLICATIONS, PROJECT DEMONSTRATION AND CASE STUDIES	**[9 hours]**
Smart Manufacturing – Predictive Maintenance – Smart Agriculture – Precision Irrigation – Smart Healthcare and Remote Patient Monitoring – Smart Buildings – Smart Energy Management – Renewable Energy Monitoring – Smart Transportation – Environmental Monitoring – Water Resource Management – Smart Cities – AIoT and Digital Twin Applications – Final Project Demonstration and Industry Case Studies.	

Total Period:45

Course outcomes:

On completion of the course, the student will have the ability to:

CO No	Course Outcomes	Cognitive Level
CO1	Identify and analyze real-world engineering problems suitable for IoT-based smart solutions.	K2
CO2	Design and develop end-to-end IoT applications integrating sensors, embedded devices, communication networks, cloud platforms, and analytics	K3
CO3	Integrate AIoT, Digital Twins, edge computing, and intelligent automation techniques to enhance the performance of IoT systems	K4
CO4	Evaluate IoT solutions based on functionality, security, scalability, sustainability, usability, and industrial applicability	K5
CO5	Demonstrate a professionally developed IoT solution with complete technical documentation, deployment, testing, and presentation	K6

COs and POs Mapping:

COs	POs										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
CO1	**3**	**1**	**1**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**1**
CO2	**3**	**2**	**1**	**1**	**3**	**-**	**-**	**-**	**1**	**1**	**1**
CO3	**3**	**2**	**3**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**1**
CO4	**2**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**1**	**2**
CO5	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**1**	**1**	**1**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Assessment	Evaluation of Different modules of work and Report	100	75	100	100
End Semester Examination (ESE)	Exam	100	25		
Total					100

TEXT BOOKS

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things – A Hands-on Approach, Universities Press, Latest Edition.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press, Latest Edition.
3. Fei Tao and Ang Liu, Digital Twin Driven Smart Manufacturing, Academic Press, 2023.

REFERENCE BOOKS

1. Raj Kamal, Internet of Things: Architecture and Design Principles, 3rd Edition, McGraw-Hill Education.
2. Perry Lea, Internet of Things for Architects, Packt Publishing.
3. Michael Grieves and John Vickers, Digital Twin: Mitigating Unpredictable, Undesirable Emergent Behavior in Complex Systems, Springer.
4. John Soldatos, Building the Industrial Metaverse: Foundations, Technologies and Applications, Springer, 2024.
5. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 2nd Edition, Apress.

WebLinks and Video Lectures (E-Resources):

1. Project identification, requirement analysis and planning- **https://www.youtube.com/watch?v=-PpAyWW5tZE**
2. Implementation, ai integration and testing- https://www.youtube.com/watch?v=
3. Deployment on Cloud and Edge Platforms-**https://www.youtube.com/watch?v=3hScMLH7B4o**
4. Smart Manufacturing – Predictive Maintenance - **https://www.youtube.com/watch?v=M9T9TFub2VM**
5. AIoT and Digital Twin Applications - **https://www.youtube.com/watch?v=2hnoGo27uf8&t=57s**

Online Course

1. https://nptel.ac.in/courses/127101872
2. https://nptel.ac.in/courses/106104242

Suggested Skill Activities:

Students shall complete the following project-oriented activities.

1. Identify an industrial or societal problem suitable for an IoT-based solution.
2. Prepare a detailed project proposal and Software Requirement Specification (SRS).
3. Design an end-to-end IoT architecture including sensors, communication, edge devices, and cloud services.
4. Develop an IoT prototype integrating sensors, embedded hardware, and cloud platforms.
5. Implement AI-based analytics or predictive models for intelligent decision-making.
6. Create dashboards for real-time monitoring, visualization, and alert generation.
7. Integrate Digital Twin concepts for monitoring or simulation where applicable.
8. Evaluate system performance, reliability, security, and energy efficiency.
9. Prepare comprehensive technical documentation, user manuals, and deployment reports.
10. Demonstrate the completed IoT solution through a technical presentation, prototype demonstration, and viva voce.

SUGGESTED CAPSTONE PROJECT DOMAINS

- Smart Manufacturing and Predictive Maintenance
- Industrial Equipment Health Monitoring
- Smart Agriculture and Precision Farming
- Smart Irrigation Systems
- Smart Healthcare and Remote Patient Monitoring
- Wearable IoT Devices
- Smart Buildings and Energy Management
- Renewable Energy Monitoring
- Smart Grid and Utility Management
- Intelligent Transportation Systems
- Fleet and Logistics Monitoring
- Environmental and Air Quality Monitoring
- Water Quality and Water Distribution Monitoring
- Smart Waste Management
- Smart Campus Automation
- Structural Health Monitoring
- Disaster Monitoring and Early Warning Systems
- Cold Chain and Supply Chain Monitoring
- AIoT-Based Home Automation
- Digital Twin-Based Industrial Monitoring