Lesson Plan No. 2	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Industry 4.0: Globalization	Course No.: ECE- 802C

Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of Industry 4.0 and its implications on globalization. b. Explore how emerging technologies are reshaping international business practices. c. Analyze the challenges and opportunities presented by Industry 4.0 in the context of globalization. d. Discuss strategies for companies to adapt and thrive in the era of Industry 4.0 and globalization..
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	    - Ask questions on Industry 4.0
	    - Ask question on industrial revolution
	    - ask question on key technologies driving Industry 4.0, such as IoT, AI, robotics, 3D printing, and big data analytics
	    - Define globalization as the increasing interconnectedness of economies, cultures, and societies on a global scale.
	2. **Development** (30 minutes)
	    - Define Industry 4.0 as the fourth industrial revolution characterized by the integration of digital technologies with traditional manufacturing and industrial processes.
	    - Explain key technologies driving Industry 4.0, such as IoT, AI, robotics, 3D printing, and big data analytics.
	    - Define globalization as the increasing interconnectedness of economies, cultures, and societies on a global scale.
	    - Provide a brief overview of the historical evolution of globalization from the Industrial revolution to the present day.
	    - explore the Input i.e. desired value or set point.
	    - Provide examples of sensing applications in industries like manufacturing, agriculture, energy, and healthcare.
	    - Discuss the role of technology, trade agreements, and multinational corporations in driving globalization.
	    - Explore how Industry 4.0 is transforming global supply chains, production networks, and trade patterns.
	    - Explain how actuators are used to control industrial processes

and machinery
- Discuss the concept of "smart factories" and how they enable real-time communication and collaboration across global manufacturing operations.
- Discuss the opportunities presented by Industry 4.0 for companies to enhance productivity, efficiency, and innovation on a global scale.
- Discuss the challenges associated with sensing and actuation in IIoT, such as data security, interoperability, and scalability.

3. Exercise (5 minutes) –
   - Short quiz or assignment on challenges and future trends in IIoT.
   - Examples of sensors and actuators

Use Nearpod to collect responses and discuss the answers.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to explain **Industry 4.0** Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Industry 4.0 & Globalization Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 3	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: The Fourth Revolution	Course No.: ECE- 802C

Objectives	At the end of the lesson the student shall be able to:
	  a. Define the Fourth Industrial Revolution (4IR) and identify its key characteristics.
	  b. Understand the impact of 4IR on various aspects of society, including economy, employment, and daily life.
	  c. Analyse the challenges and opportunities presented by Industry 4.0 in the context of globalization.
	  d. Analyse potential challenges and opportunities brought forth by 4IR.

Teaching Aids (if any)	a. Projector or slides for presentations
	  b. Small group activity sheets
	  c. Diagrams and visual aids
	  d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	  - Ask questions on technological advancements
	  - Ask question on smartphones, artificial intelligence, and automation
	  - concept of the Fourth Industrial Revolution
	  - concept of the Fourth Industrial Revolution
	  - transformation driven by technological advancements.
	  - reshaping industries, economies, and societies globally
	  - implications of 4IR on employment, workforce skills, and job displacement.
	  -
	  2. **Development** (30 minutes)
	  - Define Industry 4.0 as the fourth industrial revolution characterized by the integration of digital technologies with traditional manufacturing and industrial processes.
	  - Explain key technologies driving Industry 4.0, such as IoT, AI, robotics, 3D printing, and big data analytics.
	  - Define globalization as the increasing interconnectedness of economies, cultures, and societies on a global scale.
	  - Provide a brief overview of the historical evolution of globalization from the Industrial revolution to the present day.
	  - explore the Input i.e. desired value or set point.
	  - Provide examples of sensing applications in industries like manufacturing, agriculture, energy, and healthcare.
	  - Discuss the role of technology, trade agreements, and

	multinational corporations in driving globalization. - Explore how Industry 4.0 is transforming global supply chains, production networks, and trade patterns. - Explain how actuators are used to control industrial processes and machinery - Discuss the concept of "smart factories" and how they enable real-time communication and collaboration across global manufacturing operations. - Discuss the opportunities presented by Industry 4.0 for companies to enhance productivity, efficiency, and innovation on a global scale. - Discuss the challenges associated with sensing and actuation in IIoT, such as data security, interoperability, and scalability. 2. Exercise (5 minutes) – - Short quiz or assignment on challenges and future trends in IIoT. - Examples of sensors and actuators Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to explain **Industry 4.0** Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on Industry 4.0 & Globalization Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 4	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: The Fourth Revolution	Course No.: ECE- 802C

Objectives	At the end of the lesson the student shall be able to: a. understand the principles, techniques, and benefits of LEAN Production Systems. b. Understanding the objectives of LEAN Production Systems. c. Illustrate the LEAN aims to achieve this through continuous improvement and the elimination of non-value-added activities.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on of LEAN Production Systems - Ask question of benefits of LEAN Production Systems - Ask question of aim of LEAN Production Systems - Ask question, how LEAN Production Systems maximizing value & minimizing waste within manufacturing or service processes. - Ask question how LEAN Production Systems eliminate the Waste - Ask question how LEAN Production Systems eliminate the Waste - Ask question how LEAN Production Systems improve efficiency, reduce waste, and enhance overall performance. 2. **Development** (30 minutes) - Start with a brief introduction to LEAN Production Systems, its origin, and its purpose. - Explain that LEAN is a methodology aimed at maximizing customer value while minimizing waste. - Explain the core principles of LEAN Production Systems - Present a case study of a company that successfully implemented LEAN Production Systems. - Highlight key objectives of LEAN, such as improving quality, reducing lead time, and lowering costs. - Explain that LEAN is a methodology aimed at maximizing customer value while minimizing waste. - Produce only what is needed, when it is needed, based on

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	customer demand.
	- Analyse the entire value stream to identify waste and opportunities for improvement.
	- Explain how actuators are used to control industrial processes and machinery
	- Explain that LEAN is a methodology aimed at maximizing customer value while minimizing waste.
	2. Exercise (5 minutes) –
	- Short quiz or assignment on LEAN Production Systems
	- Examples of sensors and actuators
	Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.
	2. Homework
	Assign students to LEAN Production Systems
	Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.
	2. Nearpod Quiz on LEAN Production Systems
	Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 5	Course Name: Foundations of Internet of Things and Industry 4.0 **Topic: Smart Factories**	Course No.: ECE- 802C

Objectives	At the end of the lesson the student shall be able to:
	  a. understanding of smart factories, their key components, benefits, and challenges
	  b. understanding the impact of smart factories on manufacturing processes.
	  c. illustrate the significance of Smart Factories in the context of Industry 4.0 and the digital transformation of manufacturing

Teaching Aids (if any)	a. Projector or slides for presentations
	  b. Small group activity sheets
	  c. Diagrams and visual aids
	  d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	  - Ask questions on Smart Factories
	  - Ask question of benefits of LEAN Production Systems
	  - Ask question on key components, benefits, and challenges Smart Factories
	  - Ask question of significance of Smart Factories in the context of Industry 4.0
	  - Ask question of significance of Smart Factories in the context of digital transformation of manufacturing.
	  - Ask question how Data security and privacy concerns related to the collection and sharing of sensitive information.
	  - Integration and interoperability issues when connecting disparate systems and technologies.
	
	2. **Development** (30 minutes)
	  - explain sensors and devices connected to the internet for data collection and communication.
	  - explain algorithms that analyse data and make autonomous decisions to optimize processes.
	  - explore tools and techniques for processing and analysing large volumes of data to derive insights and improve decision-making
	  - discuss the benefits of implementing smart factory technologies
	  - explore how smart factories increased the efficiency and

productivity through automation and optimization of processes.

- explore how smart enhanced the flexibility and agility to respond quickly to market demands and changes in production requirements.
- explore how smart factories reduced costs and waste through predictive maintenance and resource optimization.
- explain the initial investment costs and infrastructure requirement for smart factories
- explain data security and privacy concerns related to the collection and sharing of sensitive information for smart factories
- explain the workforce readiness and the need for training to adapt to new technologies and processes for smart factories

2. Exercise (5 minutes) –
   - Short quiz or assignment on smart factories
   - Examples of smart factories

Use Nearpod to collect responses and discuss the answers.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to smart factories Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on smart factories Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 6	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Smart Factories	Course No.: ECE- 802C

Objectives	At the end of the lesson the student shall be able to: a. understand the concept of smart and connected businesses b. understanding the impact of integration of digital technologies and data-driven strategies to enhance operations and create value. c. illustrate the significance of Smart Factories in the context of Industry 4.0 and the digital transformation of manufacturing
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on Smart Factories - Ask question of benefits of LEAN Production Systems - Ask question on key components, benefits, and challenges Smart Factories - Ask question of significance of Smart Factories in the context of Industry 4.0 - Ask question of significance of Smart Factories in the context of digital transformation of manufacturing. - Ask question how Data security and privacy concerns related to the collection and sharing of sensitive information. - Integration and interoperability issues when connecting disparate systems and technologies. 2. **Development** (30 minutes) - explain sensors and devices connected to the internet for data collection and communication. - explain algorithms that analyse data and make autonomous decisions to optimize processes. - explore tools and techniques for processing and analysing large volumes of data to derive insights and improve decision-making - discuss the benefits of implementing smart factory technologies - explore how smart factories increased the efficiency and productivity through automation and optimization of processes.

	- explore how smart enhanced the flexibility and agility to respond quickly to market demands and changes in production requirements.
	- explore how smart factories reduced costs and waste through predictive maintenance and resource optimization.
	- explain the initial investment costs and infrastructure requirement for smart factories
	- explain data security and privacy concerns related to the collection and sharing of sensitive information for smart factories
	- explain the workforce readiness and the need for training to adapt to new technologies and processes for smart factories
	
	2. Exercise (5 minutes) –
	  - Short quiz or assignment on smart factories
	  - Examples of smart factories
	
	Use Nearpod to collect responses and discuss the answers.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to smart factories Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on smart factories Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 7	Course Name: Foundations of Internet of Things and Industry 4.0 **Topic:** Next Generation Sensors	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. understand the advancements and applications of next-generation sensors in IIoT b. Illustrate the principles of operation, technologies involved, and potential impact on various industries. c. Analyse the importance of sensors in daily lives, from smartphones to medical devices to environmental monitoring systems. d. Introduce the concept of next-generation sensors and their significance in advancing technology and addressing societal challenges.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on the importance of sensors in our daily lives - Ask question on the connection of smartphones to medical devices for environmental monitoring systems. - Ask question on concept of next-generation sensors - Ask question on the significance of advancement technology and addressing societal challenges. - Ask question on fundamental principles underlying next-generation sensors. - Ask question on Sensing Mechanisms - Ask question on Transduction Methods - Ask question on Miniaturization and Integration 2. **Development** (30 minutes) - Start with a discussion on the importance of sensors in our daily lives. - explain connection of smartphones to medical devices for environmental monitoring systems. - explore the concept of next-generation sensors and their significance in advancing technology and addressing societal challenges. - Discuss the fundamental principles underlying next-generation

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	sensors - Explain various sensing mechanisms such as optical, chemical, biological, and mechanical. - Highlight the trend towards smaller, more integrated sensor devices with improved performance. - integration of physical and computational elements in modern systems. - Present an overview of emerging sensor technologies and innovations - explain the role of sensors in enabling connectivity and data exchange in IoT ecosystems. - Explore the applications of sensors in fitness trackers, smartwatches, and healthcare monitoring devices. - Introduce the concept of sensors that can conform to irregular surfaces or stretch with the movement of the human body. - Explain how biosensors detect biological molecules and analytes for medical diagnostics, environmental monitoring, and food safety. - Discuss the principles of quantum sensing and its potential applications in precision measurement and imaging. 2. Exercise (5 minutes) – - Short quiz or assignment on Next Generation Sensors - Examples of Next Generation Sensors Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to Next Generation Sensors Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on Next Generation Sensors Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 8	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Collaborative platform and product lifecycle management	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. understand the collaborative platforms and their role in product lifecycle management (PLM) b. Illustrate the role of product lifecycle management in design, manufacturing, and distribution. c. Analyse how the collaborative platforms facilitate communication, coordination, and information sharing among stakeholders. d. Analyse the concept of product lifecycle management as the process of managing the entire lifecycle of a product from inception, through engineering design and manufacturing, to service and disposal.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on the collaborative platforms and their role in product lifecycle management - Ask question on how they facilitate communication, coordination, and information sharing among stakeholders. - Ask question on complexity of managing product development processes, including design, manufacturing, and distribution. - Ask question on how collaborative platforms integrate with various stages of the product lifecycle. - ask question to highlight the importance of collaboration in driving innovation, improving efficiency, and achieving competitive advantage in product development. 2. **Development** (30 minutes) - Explain the complexity of managing product development processes, including design, manufacturing, and distribution - explain collaborative platforms and their role in product lifecycle management (PLM). - explore the importance of collaboration among different stakeholders involved in the product lifecycle.

	- Discuss the fundamental principles underlying next-generation sensors - Explain various sensing mechanisms such as optical, chemical, biological, and mechanical. - Highlight the trend towards smaller, more integrated sensor devices with improved performance. - Discuss the role of collaborative platforms in PLM. - Explain what collaborative platforms are and how they enable stakeholders to work together regardless of geographical locations. - Highlight key features such as document management, version control, task assignment, and communication tools. - Explore the applications of sensors in fitness trackers, smartwatches, and healthcare monitoring devices. - Introduce the concept of sensors that can conform to irregular surfaces or stretch with the movement of the human body. - Discuss the advantages of using collaborative platforms in PLM, including improved communication, faster decision-making, and enhanced productivity. - Explore how collaborative platforms integrate with various stages of the product lifecycle: - - Exercise (5 minutes) – - Short quiz or assignment on Next Generation Sensors - Examples of Next Generation Sensors Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to collaborative platforms and their role in product lifecycle management Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on collaborative platforms and their role in product lifecycle management Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 9	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Augmented Reality and Virtual Reality	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. understand the Augmented Reality (AR) and Virtual Reality (VR) technologies and their applications in the Industrial Internet of Things (IIoT). b. Analyse the potential benefits, challenges, and future prospects of integrating AR and VR into industrial settings. c. Illustrate how AR overlays digital information onto the real world, while VR creates a fully immersive virtual environment d. potential benefits of integrating AR and VR into IIoT, such as reduced downtime, improved training outcomes, and enhanced decision-making.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on the collaborative platforms and their role in product lifecycle management - Ask question on how they facilitate communication, coordination, and information sharing among stakeholders. - Ask question on complexity of managing product development processes, including design, manufacturing, and distribution. - Ask question on how collaborative platforms integrate with various stages of the product lifecycle. - ask question to highlight the importance of collaboration in driving innovation, improving efficiency, and achieving competitive advantage in product development. **2. Development** (30 minutes) - Explain the Augmented Reality (AR) and Virtual Reality (VR) technologies and their applications in the Industrial Internet of Things (IIoT) - Explain the potential benefits, challenges, and future prospects of integrating AR and VR into industrial settings - Discuss the differences between AR and VR.

	- Show examples of AR and VR devices and applications. - Explain how AR overlays digital information onto the real world. - Discuss how AR & VR technologies can improve efficiency, safety, and productivity in industrial settings. - Discuss the challenges, including initial costs, technical limitations, and concerns about data security and privacy. - Explore emerging trends and future prospects of AR and VR in IIoT. - Discuss potential advancements in technology and their implications for industrial applications. - Explain the applications of AR and VR in Maintenance and repair tasks. - Explain the applications of AR and VR in Training and simulations - Explain the applications of AR and VR in Design and prototyping - Explain the applications of AR and VR in Remote assistance and collaboration - Exercise (5 minutes) – - Short quiz or assignment on Next Generation Sensors - Examples of Augmented Reality (AR) and Virtual Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to Augmented Reality (AR) and Virtual Reality (VR) Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on Augmented Reality (AR) and Virtual Reality (VR) Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 10	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Artificial Intelligence (AI)	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand the foundational concept of Artificial Intelligence (AI), its applications, and its impact on various aspects of society. b. Analyse the basic concepts, approaches, and ethical considerations related to AI. c. Explain the concept of AI and its subfields, such as machine learning, natural language processing, and robotics. d. Explore the concept of AI in various applications and industries.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on the concept of Artificial Intelligence - Ask question to define AI and its significance in today's world. - Ask question of some common examples of AI applications. - Ask question on concept of AI and its subfields, such as machine learning, natural language processing, and robotics. - Ask question on difference between narrow AI and general AI - ask question to explore various applications of AI across different industries. - ask question to explore the societal impact of AI on employment, education, and inequality. 2. **Development** (30 minutes) - Explain the fundamental concept of Artificial Intelligence (AI), its applications, and impact on various aspects of society. - Explain the concept of AI and its subfields, such as machine learning, natural language processing, and robotics. - Discuss the difference between narrow AI and general AI. - Explore various applications of AI in the field of Healthcare: Diagnosis, personalized medicine - Explore various applications of AI in the field of Finance: Fraud detection, algorithmic trading - Explore various applications of AI in the field of Education:

	Personalized learning, intelligent tutoring systems - Explore various applications of AI in the field of Customer service: Chatbots, virtual assistants - Explore emerging trends and future prospects of AR and VR in IIoT. - Explain the ethical considerations surrounding AI, such as bias, privacy, and job displacement. - Explore the societal impact of AI on employment, education, and inequality. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to Artificial Intelligence Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on Artificial Intelligence Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 11	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Big Data and Advanced Analysis	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand the big data concepts, technologies, and methodologies for advanced data analysis. b. Analyse the significance of big data in various industries, learn about tools and techniques for data processing. c. Illustrate the challenges and opportunities associated with big data analytics. d. Explore the big data and explain its characteristics: volume, velocity, variety, veracity, and value..
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on the concept of big data - Ask question based on big data concepts, technologies, and methodologies for advanced analysis. - Ask question of significance of big data in various industries, learning about tools and techniques for data processing. - Ask question about challenges and opportunities associated with big data analytics. - Ask question on Characteristics of Big Data - Explain the distributed storage and processing framework for handling large volumes of data. - ask question about Hadoop systems - ask question about Hadoop systems - ask question about NoSQL databases - 2. **Development** (30 minutes) - Explore comprehensive analysis of big data concepts, technologies, and methodologies for advanced analysis. - explore the significance of big data in various industries, learn about tools and techniques for data processing. - Explain the challenges and opportunities associated with big

	data analytics.
	- Explain the Tools and Technologies for Big Data Processing
	- Explore the popular big data technologies and frameworks
	- Explain Hadoop Systems: Explain the distributed storage and processing framework for handling large volumes of data
	- Explore the Spark: Discuss the in-memory data processing engine for real-time analytics and batch processing.
	- NoSQL databases: Explore non-relational databases designed for handling unstructured data.
	- Demonstrate how these tools are used for data ingestion, storage, processing, and analysis.
	- Explore the societal impact of AI on employment, education, and inequality.
	Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.
	2. Homework
	Assign students to explain Big Data and Advanced Analysis
	Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.
	Nearpod Quiz on Big Data and Advanced Analysis
	Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 12	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Cybersecurity in Industry 4.0	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand the cybersecurity in the context of Industry 4.0. b. Illustrate the unique challenges and threats posed by the integration of digital technologies in industrial settings. c. understand the importance of proactive risk management in safeguarding critical infrastructure. d. analyse the importance of cybersecurity in safeguarding digital assets and infrastructure.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on industry 4.0 and Cybersecurity - Ask question based on big data concepts, technologies, and methodologies for advanced analysis. - Ask question of explore the unique challenges and threats of cyber security - Ask question to define Industry 4.0 and its key components, including iot, AI, big data, and cloud computing. - Ask question to explain the importance of cybersecurity in safeguarding digital assets and infrastructure. - Explain the distributed storage and processing framework for handling large volumes of data. 2. **Development** (30 minutes) - Explore cybersecurity in the context of Industry 4.0. - Explore the unique challenges and threats posed by the integration of digital technologies in industrial settings. - Define Industry 4.0 and its key components, including IoT, AI, big data, and cloud computing. - Explain the importance of cybersecurity in safeguarding digital assets and infrastructure. - Discuss the unique cybersecurity challenges posed by Industry 4.0

	- Explore the increased attack surface due to the interconnected nature of IoT devices. - Explain the complexity of managing cybersecurity in interconnected and distributed systems. - Explain malware and ransomware. - Demonstrate the address the importance of protecting sensitive data and complying with regulations such as GDPR and CCPA. - Explore Data privacy and compliance Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to explain Cybersecurity in Industry 4.0 Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on **Cybersecurity in Industry 4.0** Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 13	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Basics of Industrial IoT	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. develop a foundational understanding of Industrial Internet of Things (IIoT) concepts, technologies, and applications b. explore how IIoT transforms traditional industrial processes, enhances efficiency, and enables data-driven decision-making. c. analyse IIoT and explain its significance in modern industrial settings d. Explore how advances in technology, such as automation, robotics, and digitalization, have paved the way for IIoT
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on understanding of Industrial Internet of Things - Ask question based on IIoT concepts, technologies, and applications - Ask question of how IIoT transforms traditional industrial processes, enhances efficiency, and enables data-driven decision-making - Ask question to explain IIOT significance in modern industrial settings - evolution of industrial systems from Industry 1.0 to Industry 4.0. - Explain the Explain fundamental concepts and principles of IIoT **2. Development** (30 minutes) - Explore IIoT and explain its significance in modern industrial settings. - Explain the evolution of industrial systems from Industry 1.0 to Industry 4.0. - Explore how advances in technology, such as automation, robotics, and digitalization, have paved the way for IIoT. - Explain the importance of cybersecurity in safeguarding digital

	assets and infrastructure.
	- Explore sensors and actuators: Discuss the role of sensors in collecting data from physical assets, and actuators in controlling processes.
	- Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus.
	- Explain the Data analytics: Introduce the importance of data analytics and predictive maintenance in extracting insights from IIoT data..
	- Explore various applications of IIoT across different industries
	- Explore the challenges and considerations associated with implementing IIoT, such as cybersecurity, interoperability, and data privacy.
	- Explore Data privacy and compliance
	Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to explain Cybersecurity in Industry 4.0 Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on basics of Industrial IoT Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 14	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: industrial sensing and actuation	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. industrial sensing and actuation technologies, their principles, applications, and significance in modern industrial systems. b. different types of sensors and actuators used in industrial environments and explore how these components enable automation, monitoring, and control in various processes c. analyse how sensors and actuators enable automation, monitoring, and optimization of industrial processes. d. Explore different types of actuators used in industrial automation
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on industrial sensing and actuation technologies - Ask question on types of sensors - Ask question on types of actuators - Ask question to explain types of actuators used in industrial automation - Ask question to explain IIOT significance in modern industrial settings - evolution of industrial systems from Industry 1.0 to Industry 4.0. **2. Development** (30 minutes) - Explore industrial sensing and actuation technologies - Explain different types of sensors and actuators used in industrial environments - explore how these components enable automation, monitoring, and control in various processes - Explore how advances in technology, such as automation, robotics, and digitalization, have paved the way for IIoT. - Define sensing and actuation in the context of industrial automation.

	- Explore sensors and actuators: Discuss the role of sensors in collecting data from physical assets, and actuators in controlling processes. - Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus. - Explain the basic principles underlying industrial sensing and actuation - Explore various applications of IIoT across different industries - Explore the challenges and considerations associated with implementing IIoT, such as cybersecurity, interoperability, and data privacy. - Explain actuation: Explain how actuators convert electrical signals into mechanical action to control devices or processes. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to explain industrial sensing and actuation Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on industrial sensing and actuation Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 15	Course Name: Foundations of Internet of Things and Industry 4.0 **Topic: Industrial Internet Systems**	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand industrial internet systems b. Analyse IIS enables data-driven decision-making, predictive maintenance, and process optimization in various industries c. Illustrate the flow of data from sensors to cloud platforms through edge devices and gateways d. Understand the role of IIS in optimizing energy consumption and reducing operational costs.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on Industrial Internet of Things (IIoT) platforms - Ask question on components, architecture, and applications in industrial settings - Ask question how IIS enables data-driven decision-making - Ask question on predictive maintenance, and process optimization in various industries. - Ask question to explain IIOT significance in modern industrial settings - Define IIS and explain its significance in modern industrial environments. - Highlight the key components and characteristics of IIS. - Illustrate the flow of data from sensors to cloud platforms through edge devices and gateways. - **2. Development** (30 minutes) - Explore Industrial Internet Systems - Explain Industrial Internet Systems - explore how these components enable automation, monitoring, and control in various processes - Explain components of Industrial Internet Systems - Define sensing and actuation in the context of industrial automation. - Explain Sensors and actuators

	- Explain Sensors and actuators - Explain connectivity: Explore different communication protocols used in IIS, such as MQTT, OPC UA, and Modbus. - Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus. - Explain the basic principles underlying industrial sensing and actuation - Explore the edge devices and gateways: Discuss the role of edge computing in processing data closer to the source and reducing latency - Explore the challenges and considerations associated with implementing IIoT, such as cybersecurity, interoperability, and data privacy. - Explain actuation: Explain how actuators convert electrical signals into mechanical action to control devices or processes. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to industrial internet systems Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on industrial internet systems Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 16	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: IIoT Reference Architecture	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand Industrial Internet of Things (IIoT) reference architecture, its components, layers, and design principles b. Analyse how IIoT reference architecture provides a framework for designing scalable, interoperable, and secure industrial systems. c. Explore the basic structure and layers of IIoT reference architecture d. Understand the flow of data and information across different layers.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions to exploring IIoT reference architecture - Ask question on components, architecture, and applications in industrial settings - Ask question how IIS enables data-driven decision-making - Ask question on designing scalable, interoperable, and secure industrial system - Ask question to Highlight the key components and objectives of IIoT reference architecture - Discuss the basic structure and layers of IIoT reference architecture. - Explain the flow of data and information across different layers. - Illustrate the flow of data from sensors to cloud platforms through edge devices and gateways. - **2. Development** (30 minutes) - Explore Industrial Internet Systems - Explain Industrial Internet Systems - explore how these components enable automation, monitoring, and control in various processes - Explain components of Industrial Internet Systems - Define sensing and actuation in the context of industrial automation.

	- Explain Sensors and actuators - Explain Sensors and actuators - Explain connectivity: Explore different communication protocols used in IIS, such as MQTT, OPC UA, and Modbus. - Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus. - Explain the basic principles underlying industrial sensing and actuation - Explore the edge devices and gateways: Discuss the role of edge computing in processing data closer to the source and reducing latency - Explore the challenges and considerations associated with implementing IIoT, such as cybersecurity, interoperability, and data privacy. - Explain actuation: Explain how actuators convert electrical signals into mechanical action to control devices or processes. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to industrial internet systems Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on industrial internet systems Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 17	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: IIoT Reference Architecture	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand Industrial Internet of Things (IIoT) reference architecture, its components, layers, and design principles b. Analyse how IIoT reference architecture provides a framework for designing scalable, interoperable, and secure industrial systems. c. Explore the basic structure and layers of IIoT reference architecture d. Understand the flow of data and information across different layers.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions to exploring IIoT reference architecture - Ask question on components, architecture, and applications in industrial settings - Ask question how IIS enables data-driven decision-making - Ask question on designing scalable, interoperable, and secure industrial system - Ask question to Highlight the key components and objectives of IIoT reference architecture - Discuss the basic structure and layers of IIoT reference architecture. - Explain the flow of data and information across different layers. - Illustrate the flow of data from sensors to cloud platforms through edge devices and gateways. - **2. Development** (30 minutes) - Explore Industrial Internet Systems - Explain Industrial Internet Systems - explore how these components enable automation, monitoring, and control in various processes - Explain components of Industrial Internet Systems - Define sensing and actuation in the context of industrial automation.

	- Explain Sensors and actuators - Explain Sensors and actuators - Explain connectivity: Explore different communication protocols used in IIS, such as MQTT, OPC UA, and Modbus. - Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus. - Explain the basic principles underlying industrial sensing and actuation - Explore the edge devices and gateways: Discuss the role of edge computing in processing data closer to the source and reducing latency - Explore the challenges and considerations associated with implementing IIoT, such as cybersecurity, interoperability, and data privacy. - Explain actuation: Explain how actuators convert electrical signals into mechanical action to control devices or processes. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to IIoT reference architecture Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on IIoT reference architecture Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 18	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: IIoT communication layer	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. understand communication layer in industrial internet of things (iiot) systems. b. understand communication protocols, standards, and technologies used for seamless data exchange between devices, sensors, and systems in industrial environments. c. analyse explain the importance of efficient and reliable communication in industrial environments. d. explore communication protocols and discuss their role in facilitating data exchange between devices and systems
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions to Exploring IIoT Communication Layers - Ask question on Data Exchange in Industrial Environments Ask question on Examples of IIoT communication protocols and technologies - Ask question on role in facilitating data exchange between devices and systems - Ask question on Wired protocols - Ask question on Wireless protocols - Ask question on wireless standards such as Wi-Fi, Bluetooth, Zigbee, and LoRaWAN - Ask question on industry standards and consortia - Ask question on open platform communications unified architecture - Ask question on Message Queuing Telemetry Transport - Ask question on ISA-95 standard for integrating enterprise and control systems 2. **Development** (30 minutes) - Explore IIoT Communication Layers - Explain Enabling Data Exchange in Industrial Environments

	- explore communication protocols, standards, and technologies used for seamless data exchange between devices, sensors, and systems in industrial environments. - Explain the importance of efficient and reliable communication in industrial environments. - Explain communication protocols and discuss their role in facilitating data exchange between devices and systems. - Explain wired protocol - Explain wireless protocol - Explain connectivity: Explore different communication protocols used in IIS, such as MQTT, OPC UA, and Modbus. - Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus. - Explain protocols such as Ethernet, Modbus, and Profibus used for wired communication in industrial networks. - Explore the edge devices and gateways: Discuss the role of edge computing in processing data closer to the source and reducing latency - Explore the wireless standards such as Wi-Fi, Bluetooth, Zigbee, and LoRaWAN for wireless connectivity in IIoT applications. - Explore the characteristics, advantages, and limitations of each type of protocol. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to communication layer Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on communication layer Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 19	Course Name: Foundations of Internet of Things and Industry 4.0 **Topic: IIoT Networking**	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. understand communication layer in industrial internet of things (iiot) systems. b. understand communication protocols, standards, and technologies used for seamless data exchange between devices, sensors, and systems in industrial environments. c. analyse explain the importance of efficient and reliable communication in industrial environments. d. explore communication protocols and discuss their role in facilitating data exchange between devices and systems
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions to Exploring IIoT Communication Layers - Ask question on Data Exchange in Industrial Environments Ask question on Examples of IIoT communication protocols and technologies - Ask question on role in facilitating data exchange between devices and systems - Ask question on Wired protocols - Ask question on Wireless protocols - Ask question on wireless standards such as Wi-Fi, Bluetooth, Zigbee, and LoRaWAN - Ask question on industry standards and consortia - Ask question on open platform communications unified architecture - Ask question on Message Queuing Telemetry Transport - Ask question on ISA-95 standard for integrating enterprise and control systems 2. **Development** (30 minutes) - Explore IIoT Communication Layers - Explain Enabling Data Exchange in Industrial Environments

	- explore communication protocols, standards, and technologies used for seamless data exchange between devices, sensors, and systems in industrial environments. - Explain the importance of efficient and reliable communication in industrial environments. - Explain communication protocols and discuss their role in facilitating data exchange between devices and systems. - Explain wired protocol - Explain wireless protocol - Explain connectivity: Explore different communication protocols used in IIS, such as MQTT, OPC UA, and Modbus. - Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus. - Explain protocols such as Ethernet, Modbus, and Profibus used for wired communication in industrial networks. - Explore the edge devices and gateways: Discuss the role of edge computing in processing data closer to the source and reducing latency - Explore the wireless standards such as Wi-Fi, Bluetooth, Zigbee, and LoRaWAN for wireless connectivity in IIoT applications. - Explore the characteristics, advantages, and limitations of each type of protocol. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to communication layer Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on communication layer Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 20	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: IIoT Business Model	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to:
	   a. understand communication layer in industrial internet of things (iiot) systems.
	   b. understand communication protocols, standards, and technologies used for seamless data exchange between devices, sensors, and systems in industrial environments.
	   c. analyse explain the importance of efficient and reliable communication in industrial environments.
	   d. explore communication protocols and discuss their role in facilitating data exchange between devices and systems

Teaching Aids (if any)	a. Projector or slides for presentations
	   b. Small group activity sheets
	   c. Diagrams and visual aids
	   d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	   - Ask questions to Exploring IIoT Communication Layers
	   - Ask question on Data Exchange in Industrial Environments
	     Ask question on Examples of IIoT communication protocols and technologies
	   - Ask question on role in facilitating data exchange between devices and systems
	   - Ask question on Wired protocols
	   - Ask question on Wireless protocols
	   - Ask question on wireless standards such as Wi-Fi, Bluetooth, Zigbee, and LoRaWAN
	   - Ask question on industry standards and consortia
	   - Ask question on open platform communications unified architecture
	   - Ask question on Message Queuing Telemetry Transport
	   - Ask question on ISA-95 standard for integrating enterprise and control systems
	
	2. **Development** (30 minutes)
	   - Explore IIoT Communication Layers
	   - Explain Enabling Data Exchange in Industrial Environments

	- explore communication protocols, standards, and technologies used for seamless data exchange between devices, sensors, and systems in industrial environments. - Explain the importance of efficient and reliable communication in industrial environments. - Explain communication protocols and discuss their role in facilitating data exchange between devices and systems. - Explain wired protocol - Explain wireless protocol - Explain connectivity: Explore different communication protocols used in IIS, such as MQTT, OPC UA, and Modbus. - Explore Connectivity: Explore different communication protocols used in IIoT, such as MQTT, OPC UA, and Modbus. - Explain protocols such as Ethernet, Modbus, and Profibus used for wired communication in industrial networks. - Explore the edge devices and gateways: Discuss the role of edge computing in processing data closer to the source and reducing latency - Explore the wireless standards such as Wi-Fi, Bluetooth, Zigbee, and LoRaWAN for wireless connectivity in IIoT applications. - Explore the characteristics, advantages, and limitations of each type of protocol. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to communication layer Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on communication layer Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 21	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Big Data Analytics	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. understand the big data analytics in IIOT b. understand the significance of Big Data Analytics in Industrial Internet of Things (IIoT) c. Introduce the topic: Explain that IIoT refers to the use of IoT (Internet of Things) technologies in manufacturing and other industrial sectors
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on big data - Ask question of analytics big data - Ask question on volume, variety, velocity, and veracity of big data - Ask question on importance of Big Data Analytics in various industries, including retail, healthcare, finance, and manufacturing - Ask question on how big data analytics has transformed businesses and improved decision-making processes. - Ask question on how IIoT integrates machinery, sensors, and software to collect and exchange data in industrial settings **2. Development** (30 minutes) - Define Big Data Analytics - Explain what constitutes "big data" (volume, variety, velocity, and veracity) - Explain the analytics techniques used to derive meaningful insights from it. - Explain how Big Data Analytics complements IIoT by analysing the vast amounts of data generated by sensors and machinery in industrial environments. - Explain the importance of efficient and reliable communication in industrial environments. **3. Exercise**

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	Ask students to explain the big data analysis. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to big data analysis. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on big data analysis. Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 22	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Software Defined Networks	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. concept of Software Defined Networks (SDN), its architecture, benefits, and applications in modern networking. b. understand the key components of an SDN architecture: the SDN Controller, Southbound APIs (e.g., OpenFlow), and Northbound APIs (e.g., RESTful APIs). c. Illustrate the concept with diagrams and examples to help students visualize how SDN differs from traditional networking approaches.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on advantages of SDN over traditional networking - Ask question on increased agility and flexibility, simplified network management, better scalability, and improved security - Ask question on Discuss real-world scenarios where SDN can address specific networking challenges - Ask question on applications of SDN across different industries - Ask question on network virtualization, traffic engineering, load balancing, and network slicing for 5G networks. 2. **Development** (30 minutes) - Define Software Defined Networks - Explain software defined networks, its architecture, benefits, and applications in modern networking - Explain traditional networking concepts and architectures. - Explain how SDN decouples the network control and forwarding functions, allowing network administrators to dynamically manage and optimize network resources through software applications. - Explore various applications of SDN across different industries, including data centres & campus networks - **3. Exercise**

	Ask students to explain the Software Defined Networks. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to types of software defined networks. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on software defined networks. Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 23	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Machine Learning and Data Science	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Define and differentiate between Machine Learning (ML) and Data Science (DS). b. Understand the basic concepts and terminology used in ML and DS. c. Identify real-world applications of ML and DS. d. Illustrate the key concepts such as algorithms, models, data pre-processing, training, and evaluation.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on difference between machine learning (ml) and data science (ds). - Ask question on basic concepts and terminology used in ml and ds - Ask question on definition of machine learning and data science - Ask question on algorithms, models, data pre-processing, training, and evaluation. - Ask question on supervised learning, unsupervised learning, and reinforcement learning. **2. Development** (30 minutes) - Explain supervised learning, unsupervised learning, and reinforcement learning. - Explain the algorithms used in ML, such as linear regression, decision trees, and neural networks. - Explain data collection, data cleaning, data analysis, and data visualization. - Discuss the importance of exploratory data analysis (EDA) in DS. - Introduce tools and techniques commonly used in DS, such as

	Python libraries (e.g., Pandas, NumPy, Matplotlib).
	- **3. Exercise**
	Ask students to explain the Machine Learning and Data Science.
	Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.
	2. Homework
	Assign students to explain Machine Learning and Data Science
	Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.
	Nearpod Quiz on Machine Learning and Data Science.
	Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 24	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Data Management with Hadoop	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Define data management with hadoop in IIOT. b. Understand the concept of industrial internet of things (IIoT) and its significance in data management. c. Explain the basics of Hadoop and its role in managing large-scale data in IIoT environments. d. Identify the components of the Hadoop ecosystem and their functionalities.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	  - Ask questions on data management with Hadoop systems
	  - Ask question on Industrial Internet of Things
	  - Ask question on open-source framework for distributed storage and processing
	  - Ask question on algorithms, models, data pre-processing, training, and evaluation.
	  - Ask question on components of Hadoop, including Hadoop Distributed File System (HDFS) and MapReduce..
	
	2. Development (30 minutes)
	  - Explain concept of Industrial Internet of Things (IIoT) and its significance in data management.
	  - Explain the basics of Hadoop and its role in managing large-scale data in IIoT environments.
	  - Explain components of the Hadoop ecosystem and their functionalities.
	  - Introduce Hadoop as an open-source framework for distributed storage and processing of large-scale data.
	  - Discuss the advantages of using Hadoop for handling big data in IIoT applications.
	3. Exercise

	Ask students to explain the data management with Hadoop systems. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to explain data management with Hadoop systems Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on data management with Hadoop systems. Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 25	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Data Center Networks	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand the role of data centre networks in supporting Industrial Internet of Things (IIoT) applications. b. Identify the unique requirements and challenges of data center networks in IIoT environments. c. Explain how different network architectures and technologies are applied in IIoT data centre networks. d. Analyse real-world case studies of IIoT data centre networking solutions.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on role of data centre networks in aggregating and processing data from IIoT devices and sensors. - Ask question on specific requirements and challenges of data center networks in IIoT - Ask question on need for secure and scalable network architectures to support the growing number of IIoT devices Ask question on algorithms, models, data pre-processing, training, and evaluation. - Ask question on network technologies and protocols commonly used in IIoT data center networks, such as MQTT, OPC UA, and CoAP. 2. **Development** (30 minutes) - Explain role of data centre networks in supporting Industrial Internet of Things (IIoT) applications. - Explain the unique requirements and challenges of data centre networks in IIoT environments. - Explain how different network architectures and technologies are applied in IIoT data center networks. - Explore the real-world case studies of IIoT data center networking solutions.

	- Explain the implications of IIoT on data center infrastructure and operations. **3. Exercise** Ask students to explain the data centre network. Use Nearpod to collect responses and discuss the answers.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to data center networks Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on data center networks Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 26	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Fog Computing & Cloud Computing	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand the concepts of fog computing and cloud computing in the context of Industrial Internet of Things (IIoT). b. Recognize the differences between fog computing and cloud computing and their respective applications in IIoT. c. Analyse real-world scenarios where Fog Computing and Cloud Computing are utilized in IIoT systems.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on fog computing - Ask question on cloud computing - Ask question on data processing and storage in IIoT systems - Ask question on fog computing as a decentralized computing infrastructure - Ask question on data processing in fog computing and cloud computing - Ask question on data processing in fog computing and cloud computing - Ask question on advantages of og Computing in IIoT **2. Development** (30 minutes) - Define fog computing as a decentralized computing infrastructure - Explain data processing occurs at the edge of the network, closer to the data source in fog computing - Discuss the advantages of fog computing in IIoT - Explain how reduced latency, improved security, and bandwidth optimization occurs in fog computing - Explore the applications of fog computing in IIoT - Explain the key components of a fog computing architecture, including edge devices, fog nodes, and the fog layer.

	3. Exercise Ask students to explain the Fog Computing & Cloud Computing
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to write short notes on Fog Computing & Cloud Computing Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on fog computing & cloud computing Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 27	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Industrial IoT in Factories and Assembly Line	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to:
	a. Understand the the concept of Industrial IoT (IIoT) and its significance in modern manufacturing.
	b. explore specific application domains of IIoT in factories and assembly lines.
	c. Analyse case studies and real-world examples to comprehend the impact of IIoT on industrial processes.
Teaching Aids (if any)	a. Projector or slides for presentations
	b. Small group activity sheets
	c. Diagrams and visual aids
	d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes)
	- Ask questions on use of IoT technologies in industrial settings
	- Ask question on cloud computing
	- Ask question on manufacturing, logistics, and supply chain management
	- Ask question on IIoT in improving operational efficiency, reducing downtime, and enabling predictive
	- Ask question on asset tracking and management
	- Ask question on quality control and defect detection
	- Ask question on real-time monitoring and optimization
	2. Development (30 minutes)
	- define the use of IoT technologies in industrial settings
	- Explain manufacturing, logistics, and supply chain management.
	- Explain the importance of IIoT in improving operational efficiency, reducing downtime, and enabling predictive maintenance
	3. Exercise
	Ask students to explain the industrial IoT (IIoT) application domains, specifically in factories and assembly lines:
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.

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	2. Homework Assign students to write short notes on ndustrial IoT (IIoT) application domains, specifically in factories and assembly lines: Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on ndustrial IoT (IIoT) application domains, specifically in factories and assembly lines: Spend 5 minutes to evaluate student assimilation of the lesson contents

Lesson Plan No. 28	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Industrial IoT in healthcare	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand the concept of Industrial Internet of Things (IIoT) in healthcare b. explore various applications and benefits of IIoT in healthcare settings. c. analyse case studies and real-world examples to understand the impact of IIoT on healthcare delivery..
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	- Ask questions on aapplication of IIoT technologies in industrial sectors, including healthcare.
	- Ask question on significance of IIoT in healthcare, focusing on its potential to improve patient care
	- Ask question on how IIoT enhance operational efficiency and reduce costs.
	- Ask question on asset tracking and management
	- Ask question on predictive maintenance of medical equipment
	- Ask question on mart hospitals and patient care automation
	   2. Development (30 minutes)
	- Explain the application of IIoT technologies in industrial sectors, including healthcare.
	- Discuss the significance of IIoT in healthcare.
	- Explain the Predictive maintenance of medical equipment
	- focus its potential to improve patient care, enhance operational efficiency, and reduce costs.
	  3. Exercise
	Ask students to explain the industrial iot in healthcare

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to write short notes on industrial IIoT in healthcare Spend 5 minutes to wrap up and consolidate the learnings

Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on industrial IIoT in healthcare Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 29	Course Name: Foundations of Internet of Things and Industry 4.0 Topic: Inventory management & quality control	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to: a. Understand the role of Industrial Internet of Things (IIoT) in inventory management and quality control. b. explore various IIoT applications and technologies used for inventory tracking and quality assurance. c. analyze case studies and real-world examples to comprehend the impact of IIoT on inventory management and quality control processes.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)
Teaching Development	1. **Introduction** (5 minutes) - Ask questions on IoT sensors for monitoring environmental conditions. - Ask question on Real-time monitoring of production processes to detect defects and deviations - Ask question on how IIoT technologies enable proactive quality control measures & leading to higher product quality control - Ask question on real-time monitoring of production processes to detect defects and deviations - Ask question on integration of IIoT with quality management systems (QMS) for continuous improvement - Ask question on IoT sensors for monitoring environmental conditions **2. Development** (30 minutes) - Explain the industrial internet of things (IIoT) in inventory management and quality control. - Explore various IIoT applications and technologies used for inventory tracking and quality assurance. - define the Industrial Internet of Things (IIoT) as the integration of IoT technologies in industrial settings, including inventory management and quality control. - Explain automated inventory replenishment systems

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	3. Exercise Ask students to explain the inventory management and quality control
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students to write short notes on inventory management and quality control Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on inventory management and quality control Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 30	Course Name: Foundations of Internet of Things and Industry 4.0 **Topic: Facility Management**	Course No.: ECE- 802C

Objectives	at the end of the lesson the student shall be able to:
	
	   a. Understand the concept of Facility Management in the context of Industrial IoT (IIoT).
	   b. explore various applications and benefits of IIoT in facility management.
	   c. analyze case studies and real-world examples to comprehend the impact of IIoT on facility operations and maintenance.

Teaching Aids (if any)	a. Projector or slides for presentations
	   b. Small group activity sheets
	   c. Diagrams and visual aids
	   d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	  - Ask questions on what facility management
	  - Ask question on the process of managing and maintaining facilities, including buildings, infrastructure, and assets.
	  - Ask question on Introduce the concept of IIoT and its application in facility management for optimizing operations and enhancing efficiency.
	  - Ask question on the significance of IIoT in enabling predictive maintenance, energy management, space utilization, and safety in facilities.
	  - Ask question on Predictive maintenance of equipment and machinery
	  Ask question on energy monitoring and optimization
	
	 2. **Development** (30 minutes)
	  - Explain the concept of Facility Management in the context of Industrial IoT (IIoT).
	  - explore various applications and benefits of IIoT in facility management.
	  - Explain the facility management as the process of managing and maintaining facilities, including buildings, infrastructure, and assets.
	  - Explain the concept of Industrial Internet of Things (IIoT) and its application in facility management for optimizing operations and enhancing efficiency.

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	3. Exercise Ask students to write a reflection paper on a specific case study or example of IIoT implementation in facility management, highlighting its impact on operational efficiency and facility performance.
Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework Assign students through quiz or short assignment covering the concepts of IIoT in facility management. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. Nearpod Quiz on facility management Spend 5 minutes to evaluate student assimilation of the lesson contents

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Lesson Plan No. 1	Course Name: Foundations of Internet of Things and Industry 4.0	Course No.: ECE- 802C
	Topic: Introduction: Sensing & actuation	

Objectives	At the end of the lesson the student shall be able to: a. Understand the concepts of Sensing and Actuation in Industrial Internet of Things (IIoT) b. Illustrate the importance of sensors and actuators in IIoT systems. c. Explore real-world applications of sensing and actuation in various industries. d. Gain insight into the challenges and future trends in IIoT sensing and actuation. e. Understand Industrial Internet of Things.
Teaching Aids (if any)	a. Projector or slides for presentations b. Small group activity sheets c. Diagrams and visual aids d. Real-world examples (videos, images, or physical examples)

Teaching Development	1. **Introduction** (5 minutes)
	   - Ask questions in Industrial Internet of Things
	   - Ask question on integration of sensors, actuators, and smart devices with industrial processes
	   - ask question on how sensors, actuators, and smart devices improve efficiency, productivity, and safety
	   - ask question on how sensing as the process of collecting data from the physical world
	
	2. **Development** (30 minutes)
	   - Define sensing as the process of collecting data from the physical world using sensors.
	   - - Discuss various types of sensors used in IIoT, such as temperature sensors, pressure sensors, proximity sensors, etc.
	   - Explain the importance of accurate and reliable sensing in industrial applications.
	   - explore the Input i.e. desired value or set point.
	   - Provide examples of sensing applications in industries like manufacturing, agriculture, energy, and healthcare.
	   - Define actuation as the process of taking actions based on the data collected by sensors.
	   - Discuss various types of actuators used in IIoT, such as motors, valves, relays, etc.
	   - Explain how actuators are used to control industrial processes

and machinery
- Provide examples of actuation applications in industries like robotics, automation, smart buildings, etc.
- Explain how sensing and actuation work together in IIoT systems to enable real-time monitoring and control.
- Discuss the challenges associated with sensing and actuation in IIoT, such as data security, interoperability, and scalability.

3. Exercise (5 minutes) –
- Short quiz or assignment on challenges and future trends in IIoT.
- Examples of sensors and actuators

Use Nearpod to collect responses and discuss the answers.

Closure	1. Summarize the Lesson Learning Outcomes and get affirmation from students on these. 2. Homework - Assign students to explain different types of sensors & actuators. Spend 5 minutes to wrap up and consolidate the learnings
Evaluation	1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss. 2. Nearpod Quiz on sensor and actuators Spend 5 minutes to evaluate student assimilation of the lesson contents

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