ANNEXURE I

TABLE 1: MODULE-WISE COURSE CONTENT AND OUTCOME				
SL. NO	**MODULE NAME**	**MODULE CONTENT**	**MODULE LEARNING OUTCOME**	**DURATION (HRS)**
1.1	Introduction to Industry 5.0 and Core Concepts	Introduction of Industry 5.0 principles and its evolution from Industry 4.0 - Understanding the role of human-centric technologies and their integration with AI, robotics, and IoT - Key technologies and tools: Cyber-Physical Systems (CPS), smart sensors, and adaptive robots - Introduction to Industry 5.0 design principles: Sustainability, inclusivity, and social responsibility - Exploring the impact of Industry 5.0 on workforce skills and automation - Understanding sustainability metrics: Economic, environmental, and social dimensions	• Implement and control basic cobots for assembly tasks • Demonstrate human-robot collaboration for simple manufacturing tasks	9 Hrs
2.	Advanced Robotics and Cobots in Manufacturing	In-depth look at collaborative robots and autonomous robots in manufacturing - Application in	• Implement robotic solutions for product customization • Monitor and optimize robot	9 Hrs

		flexible automation - production line integration and product customization - Safety and efficiency in human-robot interactions.	performance with real-time data	
3.	Data Analytics and Predictive Maintenance in IIoT	Introduction to Industrial Internet of Things (IIoT): IoT devices, sensors, and actuators - Integration of IIoT in smart factories for predictive maintenance - real-time monitoring, and optimization - Data collection and processing for enhanced decision-making in industrial operations.	• Use IIoT systems for predictive maintenance and efficiency optimization • Visualize real-time data from connected devices in a smart factory simulation	9 Hrs
4.	Edge Computing and Cloud Integration	Focus on sustainable manufacturing practices: reducing waste, energy consumption, and emissions - Personalization in production: creating individualized products at scale - Role of AI and machine learning in sustainable, eco-friendly production processes.	• Implement machine learning techniques to predict and reduce energy consumption • Customize production processes based on customer-specific needs	9 Hrs
5.	Security and Scalability in	Introduction to Cyber-Physical	• Design and implement a basic	9 Hrs

	IIoT	Systems: integrating physical processes with digital systems for enhanced control and automation - Smart factory design: decentralized decision-making, real-time data integration, and advanced control systems, Applications of CPS in autonomous production systems and intelligent supply chains.	CPS system for manufacturing processes ● Integrate sensors, robots, and software to create a functioning smart factory prototype	

TABLE 2: OVERALL COURSE LEARNING OUTCOME ASSESSMENT CRITERIA AND USECASES			
OVERALL LEARNING OUTCOME ASSESSMENT CRITERIA AND USECASES			
LEARNING OUTCOME	**ASSESSMENT CRITERIA**	**PERFORMANCE CRITERIA**	**USECASES**
Understand Industry 5.0 fundamentals.	Tests and quizzes on foundational principles.	Demonstrates clear knowledge of the transition and principles of Industry 5.0.	**Use Case 1**: Comparing automation strategies in Industry 4.0 and Industry 5.0 frameworks.
Implement human-machine collaboration.	Projects on collaborative robotics and AI integration.	Designs efficient systems that integrate human and machine strengths.	**Use Case 2:** Developing an AI-driven robotic arm for precision assembly in automotive manufacturing.
Integrate sustainability in industry.	Assignments on sustainable practices and green technology adoption.	Proposes innovative sustainability solutions for industries.	**Use Case 3:** Designing a closed-loop recycling system for a manufacturing plant**.**
Incorporate ethical considerations.	Exercises on ethics in AI and inclusive design.	Identifies potential ethical challenges and proposes solutions.	**Use Case 4**: Developing a data privacy policy for a smart factory using IoT devices.
Analyze Industry 5.0 trends and innovations.	Research on emerging trends and their implications. .	Provides insights into current and future trends, backed by data.operational	**Use Case 5:** Analyzing the role of AI in predictive maintenance for smart factories.
Optimize workflow using cobots	Practical exercises on integrating collaborative robots (cobots) in assembly lines.	Demonstrates smooth workflow integration with cobots, reducing errors and increasing efficiency.	**Use Case 6:** Designing a cobot-assisted assembly line for automotive components.

Improve employee productivity	Assignments on balancing human creativity and AI-powered automation.	Successfully improves task allocation to maximize employee productivity and job satisfaction.	**Use Case 7:** Implementing AI-powered scheduling in a manufacturing plant.
Reduce environmental impact	Projects on reducing carbon footprints using sustainable manufacturing methods.	Proposes actionable steps for reducing emissions and waste in industrial operations.	**Use Case 8:** Designing a zero-waste production line for a food packaging company.
Enhance supply chain resilience	Exercises on using IoT and AI for supply chain monitoring and optimization.	Implements robust supply chain solutions that minimize disruptions and enhance efficiency.	**Use Case 9:** Using IoT to monitor the cold chain for pharmaceutical products**.**
Develop smart factory layouts	Assignments on planning layouts for Industry 5.0-enabled factories.	Designs layouts that optimize space, human-machine interaction, and energy efficiency.	**Use Case 10:** Creating a digital twin of a factory layout to simulate workflow improvements.
Design for inclusivity	Projects on creating industrial solutions accessible to all demographics.	Proposes designs that accommodate diverse physical and cognitive abilities.	**Use Case 11:** Designing ergonomic workstations for factory workers with physical disabilities.
Implement predictive maintenance systems	Case studies on using AI for predicting and preventing machine failures.	Successfully integrates predictive analytics to reduce downtime and maintenance costs.	**Use Case 12:** Using AI-driven maintenance systems in heavy machinery operations.
Monitor energy consumption	Assignments on tracking and optimizing energy use in factories.	Implements energy monitoring systems to identify and reduce inefficiencies.	**Use Case 13:** Setting up IoT sensors to monitor energy use in a smart manufacturing plant.

Create digital training programs	Projects on using AR/VR for upskilling industrial workers.	Develops immersive training programs that improve worker skills and safety.	**Use Case 14:** Using VR simulations to train workers on operating complex machinery.
Analyze ethical impacts of AI	Assignments on evaluating ethical implications of AI in decision-making.	Identifies potential biases and proposes solutions for ethical AI implementation.	**Use Case 15:** Developing an AI decision-making framework that avoids discrimination in hiring.
Implement circular economy principles	Projects on designing products and processes that prioritize reuse and recycling.	Proposes systems that integrate circular economy practices into industrial operations.	**Use Case 16:** Designing a product lifecycle strategy for a consumer electronics company.
Enhance safety with smart technologies	Exercises on using IoT and AI for workplace safety.	Successfully implements technologies that prevent accidents and enhance worker safety.	**Use Case 17:** Deploying IoT sensors to detect hazardous gas leaks in a chemical plant.
Conduct workforce transformation analysis	Case studies on Industry 5.0's impact on job roles and skills.	Provides comprehensive insights and recommendations for workforce upskilling.	**Use Case 18:** Designing a reskilling program for factory workers transitioning to automated workflows.
Utilize AI for customer personalization	Assignments on using AI to personalized customer experiences.	Creates AI-driven solutions that cater to individual customer needs and preferences.	**Use Case 19:** Developing an AI-powered system to customize product designs for customers in the furniture industry.
Foster innovation ecosystems	Projects on building collaborative ecosystems for Industry 5.0 innovations.	Proposes ecosystems that encourage collaboration between company startups, and research institutions.	**Use Case 20:** Designing an innovation hub for startups and corporations to co-develop sustainable industrial solutions.

TABLE 4: LIST OF FINAL PROJECTS (20 PROJECTS THAT COMPREHENSIVELY COVER ALL THE LEARNING OUTCOME)

SL.NO	FINAL PROJECT
1.	Human-Robot Collaboration in Assembly Lines

2.	Predictive Maintenance in Manufacturing
3.	Customization of Consumer Products via 3D Printing
4.	Smart Warehousing and Inventory Management
5.	AI-Driven Quality Control
6.	Human-Centric Robotics in Elderly Care
7.	Smart City Infrastructure
8.	Autonomous Farming with Robotics
9.	Personalization of Health and Wellness Products
10.	Additive Manufacturing for Custom Medical Devices
11.	Sustainable Product Design and Circular Economy
12.	Real-Time AI-Powered Supply Chain Optimization
13.	Autonomous Logistics and Delivery
14.	Flexible Production Lines for Mass Customization
15.	AI-Enhanced Customer Service (Virtual Assistants)
16.	Energy Efficiency in Smart Buildings
17.	Blockchain for Transparent and Secure Supply Chains
18.	Collaborative Robots in Healthcare for Surgery Assistance
19.	Smart Packaging with IoT Sensors
20.	Automation in Custom Furniture Manufacturing

ANNEXURE III

COURSE ASSESSMENT RUBRICS (TOTAL MARKS: 70)				
ASSESSMENT CRITERIA	**DESCRIBE THE CRITERIA OF THE BELOW CATEGORY PERFORMANCE**			**TOTAL MARKS**
	FAIR	**GOOD**	**EXCELLENT**	
1	Basic integration with frequent errors. Limited ability to operate tools like cobots or IoT devices effectively.	Effective integration with occasional errors. Demonstrates familiarity with tools and technologies but lacks optimization.	Seamless and innovative integration. Effectively operates cobots, IoT, and AI technologies, demonstrating high proficiency and innovation.	20
2	Limited understanding of Industry 5.0 principles and struggles to apply them to real-world problems.	Good grasp of principles with some errors in applying them to real-world challenges.	In-depth understanding of Industry 5.0 principles, accurately applies them to solve complex challenges, and suggests	15
3	The project is incomplete or lacks coherence. Demonstrates minimal innovation and practical application.	The project meets expectations, is coherent, and includes some innovative ideas.	The project exceeds expectations with innovative, practical, and sustainable solutions. Fully addresses Industry 5.0 objectives.	25
4	Reports lack clarity and structure. Poorly articulated ideas and limited use of visual aids.	Clear and structured reports with minor issues. Ideas are well-presented with appropriate visual aids.	Highly professional reports with excellent structure, clarity, and comprehensive use of visual aids. Ideas are communicated effectively.	10