GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechanical Engineering / Mechanical Engineering (CAD/CAM) / Mechatronics Engineering / Automobile Engineering / Fabrication Technology / Information Technology

Subject Code: DI04000291

Subject Name : Industry 4.0

W. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	MOPEC

Prerequisite:	(1) Basic knowledge of manufacturing processes (2) Understanding of computer-aided design (CAD)
Rationale:	Industry 4.0, also known as the Fourth Industrial Revolution, represents a significant transformation in the manufacturing and production sectors. Enable students to apply cutting-edge technologies to optimize production processes, reduce downtime, and increase efficiency in real-world industrial settings. This syllabus will ensure that students are not just consumers of technology, but active contributors to the innovation and transformation that defines Industry 4.0.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
CO-1	Explain the evolution of industrial revolutions and the concept, scope, and significance of **Industry 4.0**
CO-2	Understand the basic concepts of Artificial Intelligence (AI) and Machine Learning (ML) and their applications in modern production systems.
CO-3	Explain the principles of Smart Manufacturing and Additive Design with applications of DfAM, 3D printing, Reverse Engineering, and IoT in modern production systems.
CO-4	Explain the concepts of Augmented Reality (AR), Virtual Reality (VR), and Collaborative Robots (Cobots), emphasizing human–machine interaction and ergonomics.
CO-5	Identify and assess safety and cybersecurity challenges in Industry 4.0 environments, ensuring safe human-robot cooperation and secure production systems.

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	00	00	100

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Industry 4.0** • Historical context: from Industry 1.0 to 4.0, • Definition, scope and significance of Industry 4.0. • Role of CAD/CAM/CAE in Industry 4.0 • Impact on mechanical engineering, manufacturing industries.	06	10
2.	**Artificial Intelligence in Production** • Machine Learning – Introduction • Features of Machine Leaning • Need for Machine Learning, • Classification of Machine Learning • Artificial Intelligence – Definition of AI, Need of AI, Goals of AI	10	20
3.	**Smart Manufacturing and Additive Design** • Design for Additive Manufacturing (DfAM) • Basics of 3D printing technologies, • Reverse engineering and 3D scanning, • Internet of Things – Introduction to IoT, Four pillars of IoT, Types of IoT , Sensors in IoT, IoT's applications in smart manufacturing	06	10
4.	**Human-Machine Interaction** • Augmented reality and Virtual reality • Fundamental concepts of AR VR Difference between AR and VR and their application in various industries, • Human-machine collaboration (cobots) and ergonomic aspects.	09	20
5	**Safety and Security in Industry 4.0** • Safety and Security in networked Production Environments • Safety with Industry 4.0, • Safety for connected Machines and Systems, Safety in Human Robot Cooperation, • Industry 4.0 optimize Safety Methods, Security & Security Risks with Industry	04	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Unit No.	Unit Name	Teaching Hours	Marks	R	U	A	N	E	C
1	Introduction to Industry 4.0	6	7	4	3	-	-	-	-
2	Artificial Intelligence in Production	10	17	6	7	4	-		-
3	Smart Manufacturing and Additive Design	10	18	-	7	4	7		-
4	Human–Machine Interaction	8	14	-	4	3	4	3	-
5	Safety and Security in Industry 4.0	8	14	-	7	-	3	4	-
	Total	**42**	**70**	**10**	**28**	**11**	**14**	**7**	**0**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asper Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. **Klaus Schwab**, *The Fourth Industrial Revolution*, World Economic Forum, 2017.
2. **Alasdair Gilchrist**, *Industry 4.0: The Industrial Internet of Things*, Apress, 2016.
3. **Mikell P. Groover**, *Automation, Production Systems and Computer-Integrated Manufacturing*, Pearson Education, 4th Edition, 2015.
4. **Alan B. Craig**, *Understanding Augmented Reality: Concepts and Applications*, Morgan Kaufmann, 2013.
5. **S. R. Jangam, S. K. Tiwari**, *Introduction to Industry 4.0 and Industrial Internet of Things (IIoT)*, Wiley India, 2020.

(b)Open sources of software and website:

1. **Free CAD** – Open-source parametric 3D CAD modeler used in design and manufacturing.
2. **TensorFlow** – Open-source AI and Machine Learning platform by Google.
3. **Opens CAD** – Open-source 3D CAD modeler for additive manufacturing.
4. **OpenXR** – Open standard for Augmented Reality (AR) and Virtual Reality (VR) development.
5. **Arduino Project Hub (IoT Applications):**https://create.arduino.cc/projecthub
6. **Cybersecurity & Infrastructure Security Agency (CISA):**https://www.cisa.gov/
7. **AI Hub (Google):**https://ai.google/tools/
8. **AR/VR Resources (NVIDIA):** https://developer.nvidia.com/arvr

Suggested Project List:

1. Case Study on Industry 4.0 Adoption in Indian Industries – Select a company (e.g., Tata Motors, Bosch, Siemens India) and analyze how Industry 4.0 technologies are implemented.)
2. AI-based Quality Inspection System (Simulation) – Develop a simple AI model to detect defects from images of products.
3. 3D Printing of a Simple Mechanical Component – Design and print a part using Free CAD and Cura/Slic3r.
4. IoT-Based Smart Factory Model – Create a small setup using Arduino and sensors to monitor parameters (temperature, vibration, etc.).
5. Ergonomic Analysis of a Workstation – Study human–machine interaction and suggest ergonomic improvements.
6. Cybersecurity Risk.
7. Poster or Report: “S Assessment of a Smart Manufacturing Setup – Identify possible threats and suggest safety measures afety and Security Challenges in Industry 4.0.”
8. Poster Presentation – “Industry 4.0 and its Impact on Mechanical Design.”

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