

**Value Added Courses  
IN  
MECHANICAL ENGINEERING**



**w.e.f. 2023 - 24**

**DEPARTMENT OF MECHANICAL ENGINEERING  
FACULTY OF ENGINEERING AND TECHNOLOGY  
GURUKULA KANGRI (DEEMED TO UNIVERISTY),  
HARIDWAR**

**Syllabus (Effective from the session 2023-24)**  
**Gurukula Kangri (Deemed to be University), Haridwar**  
**Faculty of Engineering & Technology**  
**Mechanical Engineering**  
**Value Added Courses**

S.NO.	COURSE CODE	COURSE OPTED	SUBJECT	Course Duration (in Hours)	EVALUATION SCHEME			Credit	Subject TOTAL	
					SESSIONAL EXAM.					EXAM. ESE
					CT	TA	TOTAL			
1	BME-		3R-Waste to wealth creation	30	20	10	30	70	3	100
2	BME-		Cladding for Engineering Applications	30	20	10	30	70	3	100
3	BME-		Robotics and Industrial Automation	30	20	10	30	70	3	100
4	BME-		Sustainability Biofuels and Green Energy	30	20	10	30	70	3	100
5	BME-		Waste Management and Clean Energy Production	30	20	10	30	70	3	100
6	BME-		Industrial IOT	30	20	10	30	70	3	100

Note:

1. The student will be permitted to register only one Value Added Course in one Semester from the list above.
2. No additional fee is applicable to pursue the registered Value Added Course.
3. The student shall pay the prescribed examination fee.
4. The passing requirement for the Value Added Courses shall be 50 % of the marks prescribed for the course.

**Value Added Course Code: BME-****Value Added Course Name: 3R-Waste to wealth Creation**

MM: 100 Course Duration: 30 Hr.	Sessional: 30 ESE: 70 Credit : 3
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<b>Prerequisites:</b>	None
<b>Objectives:</b>	<ol style="list-style-type: none"> <li>1. In this course students will learn the basic of plastic wastes and its sustainable utilization</li> <li>2. The students will learn the best utilization of plastic waste for a sustainable future.</li> <li>3. Social Awareness on 3R: waste to wealth creation.</li> </ol>
<b>Course Coordinator</b>	Dr. Mayank Pokhriyal and Mr. Yogesh Kumar

<b>NOTE:</b>	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain ten (10) short answer type questions of six (06) marks each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours
UNIT-1	<i>Module-1</i>	Overview of waste products, source of waste, household waste, clinical and biomedical waste, electronic waste, agricultural waste.	<b>03</b>
	<i>Module-2</i>	3R of plastic waste, Types of plastic materials and Categorization of plastic waste: bags, containers, jars, bottles, toys, polythene, stationary items, straw, disposable items etc. plastic from electronic waste, plastic from industry etc.	<b>02</b>
UNIT-2	<i>Module-3</i>	Alternative of plastic materials, how to reduce the use of plastic, degradable and non-degradable plastic materials.	<b>03</b>
	<i>Module-4</i>	Prevention, minimization and disposal of plastic waste materials, significance of reduce, reuse and recycle of plastic waste.	<b>02</b>
UNIT-3	<i>Module-5</i>	Processing Techniques for waste to wealth creation – Injection molding techniques, welding, carpentry etc.	<b>05</b>
UNIT-4	<i>Module-6</i>	Reduce and risk management of plastic material, safety grading of plastic, plastic material used for packaging of food products.	<b>02</b>
	<i>Module-7</i>	Recycle and management of plastic materials, recyclable and non-recyclable plastic material, process of recycle, equipment required, methods and applications.	<b>03</b>
UNIT-5	<i>Module-8</i>	Wealth creation from waste wooden slabs and blocks etc. Wealth creation from discarded iron material, rod, pipes etc.	<b>03</b>

	<i>Module-9</i>	Development of eco-friendly habits, awareness in children, avoid to use short term plastic. Projects making from discarded items and social awareness program for waste to wealth creation with the help of National Service Scheme (NSS).	<b>07</b>
<b>Total No. of Hours</b>			<b>30</b>

<b>Learning Outcomes:</b>	<ul style="list-style-type: none"> <li>• Understand the basics of plastic materials and different types of plastic waste</li> <li>• Understand the processing of plastics</li> <li>• To understand the 3R approach to reduce the plastic waste</li> <li>• To understand the sustainability approach for plastic utilization</li> <li>• Project making from waste or discarded item to usable products.</li> </ul>
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**Suggested books:**

<b>S. No.</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Publication</b>
1.	M.N. Subramanian, Plastic waste management, Scrivener Publishing LLC, Willey	2019
2.	J. Pichtel, waste management practices: municipal, hazardous and industrial (second edition), CRC Press	2014
3.	A. Bates, Transforming plastic: From pollution to evolution, Groundswell books	2019
4.	T.M Letcher &A.D. Vallero, waste: A handbook for management, Academic press	2019
5.	A.K.Rathore, Zero waste: management practices for environmental sustainability,CRC press	2020

**Value Added Course Code: BME-****Value Added Course Name: Cladding for Engineering Applications**

<b>MM: 100</b> <b>Course Duration: 30 Hr.</b>	<b>Sessional: 30</b> <b>ESE: 70</b> <b>Credit: 3</b>
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<b>Prerequisites:</b>	
<b>Objectives:</b>	<ol style="list-style-type: none"> <li>1. To impart knowledge regarding various advanced welding and cladding practices in industries</li> <li>2. To understand the various parameters and requirements for welding/cladding processes.</li> <li>3. To know the comparative merits and demerits of various welding/cladding processes.</li> <li>4. To understand the right kind of welding/cladding technique suitable for various joints.</li> <li>5. To learn about the joint designs adopted in different types of welding techniques</li> </ol>
<b>Course Coordinator</b>	Dr. Jasbir Singh

<b>NOTE:</b>	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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<b>UNIT</b>	<b>Course Content</b>	<b>No. of Hours</b>
UNIT-1	Introduction to welding processes, Classification of welding processes, some common concerns, types of fusion welds and types of joints, Design considerations, Post weld heating, heating processes, post heat treatments, insulation of heated joints. Introduction and classification: weld joints, weld defects, testing and inspection techniques of weldments	8
UNIT-2	Destructive Testing of weldments: hardness tests; tensile tests for groove and fillet welds-full section, reduced section and all-weld- metal tensile tests; root, face and side bend tests; fillet weld break tests; Non-Destructive Testing of Weldments: Visual inspection; Dye-penetrant inspection; Magnetic particle inspection; Ultrasonic Inspection; Radiographic Inspection, X-ray tubes, gamma-ray sources, defect discernibility; Eddy current inspection; Leak tests	7
UNIT-3	Importance of surfaces and wear surface properties in engineering applications, Current status of surface engineering. Wear modes; Categories of wear, Low stress, High stress and Goughing abrasion, Cavitation, Slurry erosion, Impingement erosion, Fretting wear, Adhesive wear, Seizure, Galling, Oxidative wear.	7
UNIT-4	Cladding processes and applications: Shielded metal arc welding, Gas tungsten arc welding, Gas metal arc welding, Flux coaxed arc welding, Submerged arc welding, Plasma arc welding oxyacetylene welding, Furnace fusing, Thermal spray processes and their applications.	8

<b>Total No. of Hours</b>	<b>30</b>
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<b>Learning Outcomes:</b>	<ul style="list-style-type: none"> <li>• Explain metal transfer mechanism and classify different types of welding process on the basis of heat sources.</li> <li>• Design and failure analysis of weldment for pressure vessels. Off-shore structures and submarine pipe lines, heavy structures.</li> <li>• Explain different non-destructive testing methods for welds.</li> </ul>
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**Suggested books:**

<b>S. No.</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Publication</b>
1.	S.P.Tewari, S.A. Rizvi, Advanced Welding Technology, S.K.Kataria & Sons	2013
2.	K. S. Yadav, Advanced Welding Tecnology, Raj Sons Publication Pvt. Ltd.	2016
3.	Lalit Thakur, Jasbir Singh, Hitesh Vasudev, Thermal Cladding for Engineering Applications, CRC Press Taylor & Francis	2023
4.	Dheerendra Kumar Dwivedi, Surface Engineering, Springer	2018

**Value Added Course Code: BME-****Value Added Course Name: Robotics and Industrial Automation**

MM: 100 Course Duration: 30 Hr.	Sessional: 30 ESE: 70 Credit : 3
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<b>Prerequisites:</b>	None
<b>Objectives:</b>	
<b>Course Coordinator</b>	Dr. Sanjeev Kumar Lambha/ Dr. Jasbir Singh

<b>NOTE:</b>	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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UNIT	Module	Course Content	No. of Hours
UNIT-1	Module-1	<b>Introduction:</b> Brief history of Robotics i.e. Definition, Three laws, Elements of Robotic Systems i.e Robot anatomy, DOF, Classification of Robotic System based on parameters as work volume, type of drive, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, Principles & strategies of Automation, Need of automation, Industrial applications of robots	3
	Module-2	<b>Grippers and Sensors for Robotics:</b> Grippers for robotics, Types of grippers, Guidelines for design of robotic gripper, Sensors for Robots, Types of sensors used in robotics, Classification and application of sensors, Selection of sensors.	4
UNIT-2	Module-3	<b>Machine Learning for Robotics:</b> Machine Learning, varieties, learning input-output functions, Types of learning, Input vectors, Outputs.	3
UNIT-3	Module-4	<b>Supervised learning:</b> Foundations of supervised learning, decision trees, Geometry and nearest neighbor's, Logistic regression, Perceptron.	4
	Module-5	<b>Unsupervised learning:</b> , Curse of dimensionality, Dimensionality reduction, Clustering, Expectation maximization algorithm-Mixture of latent variable models, Supervised learning after clustering.	4
UNIT-4	Module-6	<b>Robotic Process Automation:</b> Introduction to RPA and blue prism, Blue prism installation and architecture of blue prism, Introduction to process studio.	2
	Module-7	<b>Robotic Process Automation:</b> Data item, Calculation stage, Multi-calculation stage, Decision stage, Choice stage, Loop stage, Collection stage, Anchor stage, Note stage.	4
UNIT-5	Module-8	Debugging a process Step-in, Step-out, Break point, Creating a simple object Read stage, Write stage, Wait stage, Action stage, Navigate stage, Code stage, Creating a simple object application modeler, Spying elements, Attributes, Launch, Attach and Detach.	6
<b>Total No. of Hours</b>			<b>30</b>

<b>Learning</b>	<ul style="list-style-type: none"> <li>• Interpret terminologies related to robotics technology</li> </ul>
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<b>Outcomes:</b>	<ul style="list-style-type: none"> <li>• Understand various grippers and sensors.</li> <li>• Understand the concepts of machine learning, types of trees and bias.</li> <li>• Apply the supervised learning methods with various case studies.</li> <li>• Understand the concepts of Robotics Process Automation.</li> <li>• Applying Blue Prism tool for debugging process.</li> </ul>
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**Suggested books:**

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education	2014
2.	Dilip Kumar Pratihari, Fundamentals of Robotics, Narosa Publishing House	2019
3.	Michalski, Carbonell, Tom Mitchell, Machine Learning, Springer	2014
4.	Bruno Apolloni, Ashish Ghosh, Freda Alpasian, Machine Learning and Robot Perception, Springer	2005
5.	Lim Mei Ying, Robotic process Automation with blue prism quick start guide create software robots and automate business processes	2018
6.	Tom Tauli, The Robotic process automation Handbook: A guide to implementing RPA systems, Apress	2014

**Value Added Course Code: BME-****Value Added Course Name: Sustainability Biofuels and green energy**

<b>MM: 100</b> <b>Course Duration: 30 Hr.</b>	<b>Sessional: 30</b> <b>ESE: 70</b> <b>Credit: 3</b>
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<b>Prerequisites:</b>	
<b>Objectives:</b>	<ul style="list-style-type: none"> <li>• To understand the concepts of green Energy.</li> <li>• To know the sustainability &amp; its classification in details.</li> <li>• To understand type of biofuels and feedstocks.</li> <li>• To understand and produce biodiesel.</li> <li>• To learn broader understandings on various aspects of solid waste management practiced in industries.</li> <li>• To learn recovery of products from solid waste to compost and biogas, incineration and energy recovery.</li> </ul>
<b>Course Coordinator</b>	Dr. Sunil Kumar

<b>NOTE:</b>	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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<b>UNIT</b>	<b>Course Content</b>	<b>No. of Hours</b>
UNIT-1	Introduction to the nexus between energy, environment and sustainable development, Energy sources over view and classification, sun as the source of energy, fossil fuel reserves and resources. Introduction to Renewable Sources of Energy; Solar Energy, Wind Energy, Ocean Energy, and Bioenergy.	6
UNIT-2	Concept of Sustainability. Three pillars of sustainability. Challenges in sustainability. Need of sustainability. Nexus between technology and sustainable development. Sustainable Development Goals (SDGs).	6
UNIT-3	Bioenergy: Biomass, type of biomass. Biomass production System and their Categorization. Type of fuels. Biofuels, types of biofuels, Biofuels Properties.	6
UNIT-4	Biofuels production: - Fuel production technique. Factor affecting in process. Types of reactors. Testing of biofuels. diesel engine. Performance and emission testing of biodiesel. Future scope. Experimentation in production.	6
UNIT-5	Introduction of Municipal Solid Waste, Characteristics and Quantities, Collection, Transportation, Segregation and Processing. Energy Recovery from Municipal Solid i.e., Incineration, Landfill, Anaerobic Digestion, Gasification and Composting etc.	6
<b>Total No. of Hours</b>		<b>30</b>

<b>Learning Outcomes:</b>	<ul style="list-style-type: none"> <li>• Make interpretation about the energy sources.</li> <li>• categorize producers and consumers in an ecosystem.</li> <li>• Describe the nature and principle of different biomass energy extraction systems and know how to choose the suitable biomass fuels for different bio-energy applications.</li> <li>• Apply the basics of solid waste management towards sustainable development CO<sub>2</sub></li> <li>• Apply technologies to process waste and dispose the same.</li> </ul>
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**Suggested books:**

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bioenergy: Biomass to Biofuels-AP publisher	2014
2.	Introduction to Bioenergy (Energy and the Environment) by Vaughn C. Nelson (Author), Kenneth L. Starcher (Author)	2016
3.	Bioenergy: Sustainable Perspectives by Ted Weyland- Callisto	2016
4.	William A Worrell and P. Aarne Veslind, "Solid Waste Engineering", 2nd Edition Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)	2012
5.	White, F. R., Franke P. R., & Hindle M., Integrated solid waste management: a life cycle inventory. Mc Dougall,P. John Wiley & Sons.	2001
6	The Central Public Health and Environmental Engineering Organization (CPHEEO), "Manual on Solid Waste Management", India, 2016.	2016

**Value Added Course Code: BME-****Value Added Course Name: Waste Management and Clean Energy Production**

<b>MM: 100</b> <b>Course Duration: 30 Hr.</b>	<b>Sessional: 30</b> <b>ESE: 70</b> <b>Credit: 3</b>
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<b>Prerequisites:</b>	
<b>Objectives:</b>	<ul style="list-style-type: none"> <li>• To understand the concepts of clean Energy.</li> <li>• To learn broader understandings on various aspects of solid waste management practiced in industries.</li> <li>• To learn recovery of products from solid waste to compost and biogas, incineration and energy recovery.</li> <li>• To understand type of biofuels and feedstocks.</li> <li>• To create clean and green environment for achieving the mission of Swachh Bharat</li> </ul>
<b>Course Coordinator</b>	Kapil Dev Sharma

<b>NOTE:</b>	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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<b>UNIT</b>	<b>Course Content</b>	<b>No. of Hours</b>
UNIT-1	Introduction to the nexus between energy, environment and sustainable development, Energy sources over view and classification, Introduction to Renewable Sources of Energy; Solar Energy, Wind Energy, Ocean Energy, and Bioenergy. Introduction of Solid waste, Classification of solid waste, Solid waste management, Municipal Solid Waste Sources, composition.	6
UNIT-2	Solid waste generation and composition, waste characterization testing (physical and chemical). Waste reduction, reuse, collection, recycling, storage, transport, and disposal.	6
UNIT-3	Energy production from solid wastes, Energy Recovery from Municipal Solid i.e., Incineration, Landfill, Anaerobic Digestion, Gasification and Composting etc. Generation of Biogas and Syngas. Integrated solid waste management.	6
UNIT-4	Concept of Sustainability. Three pillars of sustainability. Challenges in sustainability. Need of sustainability. Nexus between technology and sustainable development. Sustainable Development Goals (SDGs).	6
UNIT-5	Bioenergy: Biomass, type of biomass. Type of fuels. Biofuels, Biofuels Properties. Energy production from biomass. Fuel production technique. Factor affecting in process. Types of	6

	reactors. Testing of biofuels. Performance and emission testing of biodiesel. Future scope.	
<b>Total No. of Hours</b>		<b>30</b>

<b>Learning Outcomes:</b>	<p>On successful completion of the course, the student should be able to:</p> <ul style="list-style-type: none"> <li>• State solid waste characteristics and its sources.</li> <li>• Identify and analyze different methods of treatment of solid waste.</li> <li>• To select a suitable method for waste treatment and can provide treatment flow sheet</li> <li>• Discuss the significance of recycling reuse and reclamation of solid wastes. categorize producers and consumers in an ecosystem.</li> <li>• Describe the nature and principle of different biomass energy extraction systems and know how to choose the suitable biomass fuels for different bio-energy applications.</li> </ul>
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**Suggested books:**

<b>S. No.</b>	<b>Name of Authors /Books /Publisher</b>	<b>Year of Publication</b>
1.	Bioenergy: Biomass to Biofuels-AP publisher	2014
2.	Introduction to Bioenergy (Energy and the Environment) by Vaughn C. Nelson (Author), Kenneth L. Starcher (Author)	2016
3.	Bioenergy: Sustainable Perspectives by Ted Weyland- Callisto	2016
4.	William A Worrell and P. Aarne Veslind, "Solid Waste Engineering", 2nd Edition Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)	2012
5.	White, F. R., Franke P. R., & Hindle M., Integrated solid waste management: a life cycle inventory. Mc Dougall,P. John Wiley & Sons.	2001
6	The Central Public Health and Environmental Engineering Organization (CPHEEO), "Manual on Solid Waste Management", India, 2016.	2016

**Value Added Course Code: BME-****Value Added Course Name: INDUSTRIAL IOT**

<b>MM: 100</b> <b>Course Duration: 30 Hr.</b>	<b>Sessional: 30</b> <b>ESE: 70</b> <b>Credit : 3</b>
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<b>Prerequisites:</b>	None
<b>Objectives:</b>	
<b>Course Coordinator</b>	Praveen Kumar Pandey

<b>NOTE:</b>	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus
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<b>UNIT</b>	<b>Module</b>	<b>Course Content</b>	<b>No. of Hours</b>
UNIT-1	<i>Module-1</i>	<b>Introduction to Industrial IoT (IIoT) System:</b> The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.	<b>5</b>
UNIT-2	<i>Module-2</i>	<b>Implementation systems for IIoT:</b> Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.	<b>5</b>
UNIT-3	<i>Module-3</i>	<b>IIoT Data Monitoring &amp; Control:</b> IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.	<b>5</b>
	<i>Module-4</i>	<b>Cyber Physical Systems:</b> Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis	<b>5</b>
UNIT-4	<i>Module-5</i>	<b>Industrial IoT- Applications:</b> Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.	<b>5</b>

UNIT-5	Module-6	<b>Case Studies of IIoT Systems:</b> IIoT application development with Embedded PC based development boards, Development of mini Project on new version of Operating systems and Edge development board. That project should also address to the current societal needs.	5
<b>Total No. of Hours</b>			<b>30</b>

<ul style="list-style-type: none"> <li>• <b>Learning Outcomes:</b></li> </ul>	<ul style="list-style-type: none"> <li>• Knowledge of theory and practice related to Industrial IoT Systems.</li> <li>• Ability to identify, formulate and solve engineering problems by using Industrial IoT.</li> <li>• Ability to implement real field problem by gained knowledge of Industrial applications with IoT capability</li> </ul>
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**Suggested books:**

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Industry 4.0: The Industrial Internet of Things Alasdair GilchristPublications: Apress	
2.	The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.	
3.	Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.	
4.	Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems ,River Publishers	