ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

B. Tech. Scheme of Examination & Syllabus 2023-24

INDUSTRIAL IoT

SEMESTER VII

Sr. No.	Course Category	Course Code	Course Title	Hours per Week			Credits	Maximum Marks			Minimum Passing Marks	No. of Hours for ESE
				L	T	P		Continual Assessment	End Sem Examination	Total		
1.	PCC	23II701T	Industrial IoT and Industry 4.0	3	-	-	3	30	70	100	45	3
2.	PCC	23II702P	Industrial IoT Lab	-	-	2	1	25	25	50	25	-
3.	PCC	23II703T	Cloud Computing	3	-	-	3	30	70	100	45	3
4.	PCC	23II703P	Cloud Computing Lab	-	-	2	1	25	25	50	25	-
5.	PCC	23II704T	Security and Privacy in IoT	3	-	-	3	30	70	100	45	3
6.	PEC	23II705T	Program Elective – III	3	-	-	3	30	70	100	45	3
7.	MDM	23II731M	MDM – V (Refer MDM basket)	3	-	-	3	30	70	100	45	3
8.	ELC	23II706P	Project – II	-	-	8	4	50	50	100	50	-
9.	ELC	23II707P	Summer / Winter Internship*	-	-	-	2	50	-	50	25	-
			Total	15		12	23	300	450	750		

*Summer / Winter Internship (Evaluation of Four weeks Internship Completion till 6th Semester)

Program Elective-III	
23II705T	Operations Management for Smart Manufacturing

Multidisciplinary Minor - V	
23II731M	Fundamentals of Industry 4.0 and Industrial IoT

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INDUSTRIAL IoT

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23II701T	Industrial IoT and Industry 4.0	3	-	-	3	15	15	70	100

Course Objectives	Course Outcomes
This course is intended to 1. List the key technologies and business models associated with Industrial IoT and Industry 4.0. 2. Define the foundational concepts and reference architecture of IIoT. 3. Identify various industrial data transmission technologies and their applications in IIoT. 4. Implement industrial data acquisition and analytics techniques in IIoT systems.	Student will be able to 1. To List different business models and reference architectures in the context of IIoT and Industry 4.0. 2. To define the significance and impact of key technologies such as cloud computing, fog computing, and augmented reality in IIoT systems. 3. To identify various industrial data transmission technologies and understand their role in IIoT implementation. 4. To implement IIoT analytics techniques using artificial intelligence tools and analyze their effectiveness in industrial processes. 5. To define the key drivers and applications of Industry 4.0 and IIoT in different industries.

Unit I: Basics of IIoT, Business models & Reference Architecture of IIoT **[9 Hrs]**

Introduction, Design requirements of Industry 4.0, Drivers of Industry 4.0, Sustainability Assessment of industries, Smart business perspective, cybersecurity, Impact of Industry 4.0, Industrial Internet Systems, Industrial sensing, Industrial Processes. Definition of a business model, Business models of IoT, Business models of IIoT, Reference architecture of IoT, Reference architecture of IIoT, IIRA, Key performance indicators for occupational Safety and health

Unit II: Key Technologies: Off-site and On-site Technologies **[9 Hrs]**

Introduction, Cloud Computing, Necessity of cloud computing, cloud computing and IIoT, Industrial cloud platform providers, SLA for IIoT, requirements of industry 4.0 and its solution, fog computing for IIoT, Application of fog and their solutions, Augmented reality, virtual reality, big data and advance analytics, smart factories

Unit III: Industrial Data Transmission **[9 Hrs]**

Foundation Fieldbus, Profibus, HART, Interbus, Bitbus, CC-link, Modbus, batibus, Digital STROM, Controller area network, device Net, LonWorks, Wireless HART, LoRa and LoRaWAN, Recent and Upcoming Technologies

Unit IV: Industrial Data Acquisition and Introduction to IIoT Analytics **[9 Hrs]**

Introduction, Distributed Control System, PLC, SCADA, Necessity of analytics, IIoT Analytics, Categorization of analytics: IIoT and industry 4.0 context, usefulness of IIoT analytics, challenges of analytics in industries, Deployment of analytics, Artificial intelligence

Unit V: Overview of Industry 4.0 and Industrial Internet of Things **[9 Hrs]**

IoT Architecture, Application Based IoT Protocols, Cloud Computing, Fog Computing, Sensor Cloud, Big Data. Overview of Industry 4.0 and Industrial Internet of Things: Industry 4.0, IIoT, Basics of CPS, CPS and IIoT, Application of IIoT. Design requirements of Industry 4.0, Drivers of Industry 4.0, Sustainability Assessment of industries, Smart business perspective, cybersecurity, Impact of Industry 4.0

Text Book

S.No	Title	Authors	Edition	Publisher
1.	Introduction to Industrial Internet of Things and Industry 4.0	Sudip Misra, Chandana Roy, and Anandarup Mukherjee	First edition	2021

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INDUSTRIAL IoT

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23II702P	Industrial IoT Lab	---	---	2	1	25	25	50

Course Objectives	Course Outcomes
1. To understand industrial IoT architecture, communication protocols, and integration of sensors, controllers, and industrial equipment. 2. To develop skills in designing and implementing real-time industrial monitoring, control, and automation solutions using IIoT technologies.	1. Describe and implement industrial communication protocols such as TCP/IP, MQTT, HTTP, Modbus, and Profibus in IIoT systems. 2. Develop applications for remote monitoring and control of industrial equipment using sensors, microcontrollers, and web dashboards. 3. Design alert and reporting systems using SMS, email, and cloud-based communication technologies. 4. Analyze and visualize industrial data through dashboards for monitoring, energy management, and anomaly detection. 5. Build integrated IIoT solutions for automation, centralized monitoring, and smart industrial applications

Expt. No.	Title of the experiment
1	Remote Monitoring and Control of Industrial Equipment.
2	Field Equipment Control and Monitoring.
3	SMS Alerts System.
4	Email Alert and Reporting System.
5	HX – Sensors – Remote Operations.
6	HX – Smart Sensors – Analysis Tool.
7	HX – Energy Meter – Auto Billing & Reporting.
8	HX – Centralized Monitoring System.
9	HX – Remote Monitoring System.
10	HX – Anomaly Detection System.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Internet of Things: A Hands-On Approach	Arshdeep Bahga, Vijay Madisetti	--	Universities Press
2	Industrial Internet of Things	Alasdair Gilchrist	1st	Apress
3	IoT Fundamentals: Networking Technologies, Protocols and Use Cases	David Hanes, Gonzalo Salgueiro, Patrick Grossetete	1st	Cisco Press
4	Designing the Internet of Things	Adrian McEwen, Hakim Cassimally	1st	Wiley

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Hands-On Industrial Internet of Things	Giacomo Veneri, Antonio Capasso	1st	Packt Publishing
2	Industrial Automation and Control System Security Principles	David J. Teumim	1st	Elsevier
3	SCADA Systems and the Internet of Things	Pao Ann Hsiung, et al.	1st	CRC Press
4	Practical Industrial Data Communications	Deon Reynders, Steve Mackay	--	Elsevier

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SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23II703T	Cloud Computing	3	---	---	3	15	15	70	100

Course Objectives	Course Outcomes
This course is intended 1. To provide students with a solid foundation in the principles and architecture of cloud computing. 2. To familiarize students with different cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid). 3. To enable students to design, implement, and manage cloud-based applications and services, focusing on real-world applications in the context of IoT.	**Students will be able to** 1. To describe the fundamental concepts of cloud computing, including its history, definitions, and basic architectures. 2. To identify and use different cloud infrastructure components and services to build scalable and efficient cloud-based solutions. 3. To integrate cloud computing with IoT systems to design and deploy scalable IoT solutions. 4. To develop, deploy, and manage applications in a cloud environment, using industry-standard tools and practices. 5. To analyze and discuss advanced cloud computing topics and emerging trends, preparing them for future developments in the field.

Unit I:	**[9 Hrs]**
Introduction to Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid), Cloud Service Providers and Market Trends, Key Cloud Computing Technologies and Components.	
Unit II:	**[8 Hrs]**
Virtualization Technologies, Cloud Storage and Databases, Networking in the Cloud Compute Resources and Load Balancing, Cloud Security and Compliance	
Unit III:	**[10 Hrs]**
IoT Architecture and Components, Cloud-Based IoT Platforms and Services, Data Collection, Storage, and Analysis in Cloud, IoT Data Management and Processing, Case Studies of Cloud-Based IoT Applications	
Unit IV:	**[10 Hrs]**
Cloud Application Development Tools and Frameworks, Continuous Integration and Continuous Deployment (CI/CD) in the Cloud, Monitoring and Performance Optimization, Cloud Cost Management, Disaster Recovery and Backup Strategies	
Unit V:	**[8 Hrs]**
Serverless Computing and Function-as-a-Service (FaaS), Cloud-Native Technologies (e.g., Containers, Kubernetes), Future Directions and Emerging Trends in Cloud Computing , Introduction to Fog Computing.	

Text and Reference Books

SNo	Title	Authors	Edition/year	Publisher
1	Cloud Computing: Principles, Systems and Applications	Nikos Antonopoulos & Lee Gillam	2017	Springer
2	Cloud Computing: Concepts, Technology & Architecture	Thomas Erl, Zaigham Mahmood, and Ricardo Puttini	2013	Prentice Hall
3	Cloud Computing: A Hands-On Approach	Arshdeep Bahga & Vijay Madisetti	2014	VPT

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SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
23II703P	Cloud Computing Lab		-	2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended 1. To provide a thorough understanding of cloud computing principles, including various service and deployment models, and their advantages and limitations. 2. To enable students to practically utilize cloud services for deploying and managing applications, databases, and other infrastructure components in a scalable and efficient manner. 3. To equip students with the skills necessary to integrate cloud computing with IoT systems and develop cloud-based solutions.	**Students will be able to** 1. Describe the key concepts, service models (IaaS, PaaS, SaaS), and deployment models (public, private, hybrid) of cloud computing. 2. Utilize cloud platforms to deploy, configure, and manage various services and applications, including virtual machines, storage solutions, and databases. 3. Design and implement cloud-based solutions that effectively integrate with IoT devices and platforms. 4. Practical experience with serverless computing and its applications. 5. Knowledge of advanced cloud technologies and trends, with practical implementation experience.

Sr. No.	List of Practicals
1	Introduction to Cloud Computing. Overview of Public Cloud Platforms- AWS, Google Cloud and Azure. Create accounts on major cloud platforms (e.g., AWS, Microsoft Azure, Google Cloud Platform)
2	Navigate through the AWS cloud console/dashboard and exploring the basic features and services available on AWS Console.
3	Creation AWS EC2 Windows Instance and access it from Desktop windows machine.
4	Creation of Simple Storage Service (S3) buckets in AWS. Add file to the folder inside bucket crated and update it.
5	Create Elastic Block Storage, attach it to EC2 Instance and detach it from EC2 instance.
6	Create Ubuntu- AWS EC2 instance. Install Nginx in EC2 instance and Deploy Sample application.
7	Create AWS IAM User, Group, Security Group, and Policy.
8	Create Elastic/ Static IP, attach it to EC2 instance and detach it from EC2 instance.
9	Create Elastic Load Balancer - Application Load balancer in AWS.
10	Set up a cloud database instance (e.g., RDS in AWS, SQL Database in Azure) and Perform basic database operations (e.g., create tables, insert and query data).
11	Set up an IoT platform (e.g., AWS IoT Core, Azure IoT Hub). Simulate data from IoT devices and send it to the cloud.
12	Experiment with advanced cloud technologies (e.g., Kubernetes, Docker). Set up a basic container orchestration environment using Kubernetes.

Text and Reference Books

S.N	Title	Authors	Edition	Publisher
1	Architecting the Cloud: Design Decisions for Cloud Computing Success	Michael J. Kavis, Wiley	--	Universities Press

2	Cloud Computing for Dummies	Judith Hurwitz, Robin Bloor, Marcia Kaufman, and Fern Halper	1st	2009 Wiley
3	Cloud Computing for IoT	Rajkumar Buyya, James Broberg, and Andrzej Goscinski	1st	Wiley
4	Designing the Internet of Things	Adrian McEwen, Hakim Cassimally	1st	

SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23II704T	Security and Privacy in IoT	3	-	-	3	15	15	70	100

Course Objectives	Course Outcomes
To provide students with fundamental knowledge of IoT security, privacy, cryptography, cloud security, and ethical considerations for designing secure and trustworthy IoT systems.	1. Explain IoT security concepts, vulnerabilities, attacks, and secure design principles. 2. Apply cryptographic techniques and security lifecycle practices for securing IoT systems. 3. Analyze cloud security mechanisms and threats in cloud-enabled IoT environments. 4. Evaluate IoT privacy challenges and implement privacy engineering and Privacy-by-Design principles. 5. Discuss ethical, social, and environmental issues associated with the Internet of Things.

Unit I:	**[10 Hours]**
Cybersecurity versus IoT security and cyber-physical systems, The IoT of the future and the need to secure**,** The future – cognitive systems and the IoT, Vulnerabilities, Attacks, and Countermeasures, Primer on threats, vulnerability, and risks (TVR), Primer on attacks and countermeasures, Today's IoT attacks, Attacks, Lessons learned and systematic approaches, building security in to design and development, Secure design	
Unit II:	**[10 Hours]**
The IoT Security Lifecycle, the secure IoT system implementation lifecycle, Cryptographic Fundamentals for IoT Security Engineering, Cryptography and its role in securing the IoT, Cryptographic module principles Cryptographic key management fundamentals, Examining cryptographic controls for IoT protocols, Future directions of the IoT and cryptography	
Unit III:	**[8 Hours]**
Cloud Security for the IoT, Cloud services and the IoT, exploring cloud service provider IoT offerings, Cloud IoT security controls, Tailoring an enterprise IoT cloud security architecture, new directions in cloud-enabled IOT computing, Threats both to safety and security	
Unit IV:	**[10 Hours]**
Mitigating IoT Privacy Concerns, Privacy challenges introduced by the IoT, Guide to performing an IoT PIA, PbD principles, Privacy engineering recommendations,	
Unit V:	**[7 Hours]**
Ethics**,** Characterizing the Internet of Things, Privacy, Control, Disrupting Control, Crowdsourcing, Environment, Physical Thing, Electronics, Internet Service, Solutions, The Internet of Things as Part of the Solution, Cautious Optimism, The Open Internet of Things Definition	

Text Books

S. No.	Title	Authors	Edition	Publisher
1.	Practical Internet of Things Security.	Russell, Brian, and Drew Van Duren	I	Packt Publishing Ltd.
2.	Designing the Internet of Things	Adrian McEwen, Hakim Cassimally	I	Wiley

Reference Books

S. No.	Title	Authors	Edition	Publisher
1.	Security and Privacy in Internet of things (IoTs): Models, Algorithms, and Implementations	Hu, Fei.	I	CRC Press

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SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23II705T	PE – III Operations Management for Smart Manufacturing	3	---	---	3	15	15	70	100

Course Objectives	Course Outcomes
1. Develop an understanding of fundamental Operations Management concepts and their role in manufacturing systems. 2. Relate product, process, and facility design principles to smart and digitally enabled manufacturing environments. 3. Apply planning, scheduling, and control concepts for effective management of IoT-enabled manufacturing operations. 4. Understand quality and materials management practices in the context of smart manufacturing and Industry 4.0.	1: Explain the role of Operations Management in manufacturing systems and its evolution towards smart and connected industrial environments. 2: Apply product and process design concepts, including DFX and rapid prototyping, in digitally supported manufacturing systems. 3: Analyze forecasting, capacity planning, and facility planning concepts using data generated from IoT-enabled manufacturing systems. 4: Interpret production planning, scheduling, and control techniques in automated and IoT-integrated manufacturing operations. 5: Describe quality and materials management practices using smart monitoring, data collection, and decision-support systems.

Unit I: Introduction to Operations Management	**[7 Hrs]**
Introduction to operations management, objectives, functions, and scope, types of production systems and operations strategy, role of operations management in manufacturing organizations, overview of traditional manufacturing systems and transition towards smart manufacturing systems, concept of smart factory and digital manufacturing environment, role of Industrial Internet of Things (IIoT), cyber physical systems and data connectivity in modern manufacturing operations.	
Unit II: Product and Process Design	**[10 Hrs]**
Product life cycle, value engineering, ergonomics in product design, Design for X (DFX) concepts, process selection and process design concepts, introduction to rapid prototyping and additive manufacturing in product development, role of computer aided design and digital design tools in product and process development, use of digital modelling and simulation tools for improving product design and manufacturing efficiency in smart manufacturing environments.	
Unit III: Forecasting, Capacity and Facility Planning	**[8 Hrs]**
Demand forecasting concepts and forecasting systems, qualitative and quantitative forecasting methods (conceptual), role of data driven forecasting using manufacturing data, capacity planning basics in manufacturing systems, facility planning, factors affecting plant location, location evaluation methods, introduction to plant layout concepts, role of digital factory planning tools and smart facility design for efficient manufacturing operations.	
Unit IV: Production Planning, Scheduling and Control	**[10 Hrs]**
Production planning and control functions, process planning, aggregate production planning, master production scheduling (MPS), sequencing principles in manufacturing systems, introduction to project scheduling concepts using CPM and PERT, role of information systems in production control, introduction to Manufacturing Execution Systems (MES), real time production monitoring and control using IoT enabled manufacturing systems.	
Unit V: Quality and Materials Management	**[10 Hrs]**
Concept of quality, Total Quality Management (TQM), Total Productive Maintenance (TPM), Six Sigma (introductory), Statistical Quality Control (basic concepts), materials management concepts, inventory control concepts, Economic Order Quantity (EOQ) conceptual approach, Just in Time (JIT), Kanban system, Material Requirement Planning (MRP), Enterprise Resource Planning (ERP), role of smart sensors, RFID and digital monitoring systems for quality assurance, predictive maintenance and smart materials management in manufacturing systems.	

TEXT BOOKS

S. No.	Title	Authors	Edition	Publisher
1	Operations Management	Jay Heizer, Barry Render, Chuck Munson	12th Edition (2017)	Pearson Education
2	Operations Management: Processes and Supply Chains	Lee J. Krajewski, Larry P. Ritzman, Manoj K. Malhotra	13th Edition(2018)	Pearson Education
3	Smart Manufacturing: Integrating Manufacturing and Digital Technologies	Shahrukh A. Irani	1st Edition(2019)	McGraw Hill Education

REFERENCE BOOKS

S. No.	Title	Authors	Edition	Publisher
1	Manufacturing Planning and Control Systems for Supply Chain Management	Thomas E. Vollmann, William L. Berry, D. Clay Whybark, F. Robert Jacobs	6th Edition	McGraw-Hill Education
2	Lean Production Simplified	Pascal Dennis	3rd Edition	CRC Press (Taylor & Francis)
3	Smart Manufacturing Systems	Masoud Soroush, Ali S. Hadi	1st Edition	Wiley

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SEVENTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation			
						MSE	CA	ESE	Total
23II731M	MDM – V Fundamentals of Industry 4.0 and Industrial IoT	3	-	-	3	15	15	70	100

Course Objectives	Course Outcomes
This course is intended to 1. Define the concepts and technologies associated with Industry 4.0 and Industrial Internet of Things. 2. Identify the key drivers and applications of Industry 4.0 and IIoT in various industries 3. Analyze business models and reference architectures related to IIoT. 4. Demonstrate knowledge of off-site and on-site technologies, including cloud computing and fog computing, in the context of IIoT.	Student will be able to 1. To list the components of Industry 4.0 and Industrial Internet of Things. 2. To define the key drivers and applications of Industry 4.0 and IIoT in different industries. 3. To explain various business models and reference architectures associated with Industrial Internet of Things. 4. To demonstrate practical knowledge of off-site and on-site technologies in the context of IIoT.

Unit I : Overview of Industry 4.0 and Industrial Internet of Things **[9 Hours]**

Introduction, IoT Architecture, Application Based IoT Protocols, Cloud Computing, Fog Computing, Sensor Cloud, Big Data. Overview of Industry 4.0 and Industrial Internet of Things: Industry 4.0, IIoT, Basics of CPS, CPS and IIoT, Application of IIoT.

Unit II: Basics of Industry 4.0 and Industrial Internet of Things **[9 Hours]**

Introduction, Design requirements of Industry 4.0, Drivers of Industry 4.0, Sustainability Assessment of industries, Smart business perspective, cybersecurity, Impact of Industry 4.0, Industrial Internet Systems, Industrial sensing, Industrial Processes.

Unit III: Business Models and Reference Architecture of IIoT **[9 Hours]**

Introduction, Definition of a business model, Business models of IoT, Business models of IIoT, Reference architecture of IoT, Reference architecture of IIoT, IIRA, Key performance indicators for occupational Safety and health.

Unit IV: Key Technologies: off-site and on-site Technologies **[10 Hours]**

Introduction, Cloud Computing, Necessity of cloud computing, cloud computing and IIoT, Industrial cloud platform providers, SLA for IIoT, requirements of industry 4.0 and its solution, Fog computing for IIoT, Application of Fog and their solutions.

Unit V: Case Studies **[8 Hours]**

Introduction, Manufacturing Industry, Automotive Industry, Mining Industry, Background of the industry, challenges, Industrial IoT as a solution, benefits.

Text Books

S. N	Title	Authors	Edition	Publisher
1.	Introduction to Industrial Internet of Things and Industry 4.0	Sudip Misra, Chandana Roy, and Anandarup Mukherjee	First edition	2021

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