SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT

OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

VI SEMESTER

PEI103 - INDUSTRY 4.0 FOR PROCESS INDUSTRIES

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SUBJECT : PEI103 - INDUSTRY 4.0 FOR PROCESS INDUSTRIES

SEM / YEAR : VI / III

UNIT I - INTRODUCTION TO INDUSTRY 4.0

Overview of Industrial Revolutions, Historical Context, General framework, Introduction to Internet of Things (IoT) and Industrial Internet of Things (IIoT), Key Characteristics of Industry 4.0, Communication technologies (Wi-Fi, 5G, LPWAN, etc.), IoT platforms and protocols (MQTT, CoAP), IoT in smart manufacturing and logistics Apply areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development.

PART - A

S.No	Questions	CO's	BTL Level	Competence
1.	Define Industry 4.0.	CO1	BTL1	Knowledge
2.	List the four industrial revolutions in order.	CO1	BTL1	Knowledge
3.	What is meant by Cyber-Physical Systems (CPS)?	CO1	BTL1	Knowledge
4.	Define Internet of Things (IoT).	CO1	BTL1	Knowledge
5.	Differentiate between IoT and IIoT.	CO1	BTL2	Understand
6.	State any two key characteristics of Industry 4.0.	CO1	BTL1	Knowledge
7.	What is smart manufacturing?	CO1	BTL1	Knowledge
8.	Mention two Applys of IoT in logistics.	CO1	BTL1	Knowledge
9.	What is LPWAN? Give one example.	CO1	BTL1	Knowledge
10.	What role does data analytics play in Industry 4.0?	CO1	BTL2	Understand
11.	Define Industrial Internet of Things (IIoT).	CO1	BTL1	Knowledge
12.	List any two enabling technologies of Industry 4.0.	CO1	BTL1	Knowledge
13.	What is MQTT?	CO1	BTL1	Knowledge
14.	What is CoAP protocol used for?	CO1	BTL1	Knowledge
15.	Identify two benefits of Industry 4.0.	CO1	BTL2	Understand
16.	What is meant by interoperability in Industry 4.0?	CO1	BTL2	Understand
17.	Name any two IoT communication technologies.	CO1	BTL1	Knowledge
18.	What is cloud computing in the context of IoT?	CO1	BTL2	Understand
19.	What is meant by smart factory?	CO1	BTL1	Knowledge
20.	State the role of sensors in IoT systems.	CO1	BTL2	Understand
21.	What is the significance of 5G in Industry 4.0?	CO1	BTL2	Understand
22.	Define automation.	CO1	BTL1	Knowledge
23.	Mention two disciplines contributing to Industry 4.0.	CO1	BTL1	Knowledge
24.	What is real-time monitoring?	CO1	BTL1	Knowledge

PART B

1.	Explain the evolution of industrial revolutions with suitable examples.**(16)**	CO1	BTL3	Apply
2.	Describe the general framework of Industry 4.0 in detail. **(16)**	CO1	BTL4	Analyze
3.	Discuss the architecture of IoT and its role in smart manufacturing. **(16)**	CO1	BTL4	Analyze

4.	Compare IoT and IIoT with respect to Applys, challenges, and benefits. **(16)**	CO1	BTL4	Analyze
5.	Explain the key characteristics of Industry 4.0 and their significance. **(16)**	CO1	BTL3	Apply
6.	Analyze the role of communication technologies such as Wi-Fi, 5G, and LPWAN in Industry 4.0. **(16)**	CO1	BTL4	Analyze
7.	Describe MQTT and CoAP protocols with suitable use cases. **(16)**	CO1	BTL3	Apply
8.	Discuss IoT-based smart manufacturing systems and their advantages. **(16)**	CO1	BTL3	Apply
9.	Explain the Applys of IoT in logistics and supply chain management. **(16)**	CO1	BTL3	Apply
10.	Analyze the impact of Industry 4.0 on traditional manufacturing industries. **(16)**	CO1	BTL4	Analyze
11.	Explain how IoT platforms support data collection, processing, and decision-making. **(16)**	CO1	BTL3	Apply
12.	Discuss the challenges and opportunities in implementing Industry 4.0. **(16)**	CO1	BTL5	Evaluate
13.	Evaluate the role of Industry 4.0 in achieving sustainable manufacturing. **(16)**	CO1	BTL5	Evaluate
14.	Illustrate the dissemination of Industry 4.0 across different industrial sectors. **(16)**	CO1	BTL3	Apply
15.	Analyze the interdisciplinary nature of Industry 4.0 development. **(16)**	CO1	BTL4	Analyze
16.	Propose an IoT-based solution for a smart factory environment. **(16)**	CO1	BTL6	Create
17.	Design a conceptual model showing IoT integration in Industry 4.0. **(16)**	CO1	BTL6	Create

UNIT II - INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM

Introduction to Cyber Physical Systems (CPS), Components of CPS, Architecture and design principles of CPS, Differences between CPS and traditional embedded systems. Data science and technology for CPS, Emerging Applys in CPS in different fields. Case study: Apply of CPS in health care domain and Manufacturing.

PART - A

S.No	Questions	CO's	BTL Level	Competence
1.	Define Cyber Physical System (CPS).	CO2	BTL1	Knowledge
2.	List the major components of CPS.	CO2	BTL1	Knowledge
3.	What is CPS architecture?	CO2	BTL1	Knowledge
4.	State any two design principles of CPS.	CO2	BTL1	Knowledge
5.	Differentiate CPS from embedded systems.	CO2	BTL2	Understand
6.	What is the role of sensors in CPS?	CO2	BTL2	Understand
7.	Define actuator in CPS.	CO2	BTL1	Knowledge
8.	What is real-time control?	CO2	BTL2	Understand
9.	Define data science in CPS.	CO2	BTL1	Knowledge

10.	Mention two CPS Applys in manufacturing.	CO2	BTL1	Knowledge
11.	Mention two CPS Applys in healthcare.	CO2	BTL1	Knowledge
12.	What is feedback loop in CPS?	CO2	BTL1	Knowledge
13.	What is cyber layer of CPS?	CO2	BTL1	Knowledge
14.	What is physical layer of CPS?	CO2	BTL1	Knowledge
15.	Define interoperability in CPS.	CO2	BTL2	Understand
16.	What is CPS security?	CO2	BTL2	Understand
17.	What is predictive analytics in CPS?	CO2	BTL2	Understand
18.	Define digital twin.	CO2	BTL1	Knowledge
19.	What is cloud integration in CPS?	CO2	BTL2	Understand
20.	What is CPS-based automation?	CO2	BTL1	Knowledge
21.	Mention two challenges in CPS implementation.	CO2	BTL2	Understand
22.	What is data acquisition in CPS?	CO2	BTL1	Knowledge
23.	What is networked control system?	CO2	BTL1	Knowledge
24.	What is intelligent decision making in CPS?	CO2	BTL2	Understand
	PART B			
1.	Explain CPS architecture with neat diagram. **(16)**	CO2	BTL3	Apply
2.	Discuss components and design principles of CPS. **(16)**	CO2	BTL3	Apply
3.	Analyze differences between CPS and traditional embedded systems. **(16)**	CO2	BTL4	Analyze
4.	Explain the role of data science and analytics in CPS. **(16)**	CO2	BTL3	Apply
5.	Discuss emerging Applys of CPS in different fields. **(16)**	CO2	BTL3	Apply
6.	Analyze CPS-based smart manufacturing systems. **(16)**	CO2	BTL4	Analyze
7.	Explain CPS Applys in healthcare with suitable examples. **(16)**	CO2	BTL3	Apply
8.	Evaluate security and privacy challenges in CPS. **(16)**	CO2	BTL5	Evaluate
9.	Analyze the role of CPS in Industry 4.0. **(16)**	CO2	BTL4	Analyze
10.	Explain the concept of digital twin in CPS. **(16)**	CO2	BTL3	Apply
11.	Discuss real-time monitoring and control in CPS. **(16)**	CO2	BTL3	Apply
12.	Analyze communication technologies used in CPS. **(16)**	CO2	BTL4	Analyze
13.	Evaluate CPS implementation challenges in industries. **(16)**	CO2	BTL5	Evaluate
14.	Propose a CPS solution for healthcare monitoring. **(16)**	CO2	BTL6	Create
15.	Design a CPS model for smart manufacturing. **(16)**	CO2	BTL6	Create
16.	Develop a conceptual CPS framework for Industry 4.0. **(16)**	CO2	BTL6	Create
17.	Justify the importance of CPS in modern automation systems. **(16)**	CO2	BTL5	Evaluate

UNIT III - SMART ENERGY SOURCES

Energy Storage for Mitigating the variability of Renewable Electricity Sources, Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation. Smart grid definition and development Smart Grid, Understand the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0.

PART – A

S.No	Questions	CO's	BTL	Competence

			Level	
1.	Define renewable energy variability.	CO3	BTL1	Knowledge
2.	What is energy storage system (ESS)?	CO3	BTL1	Knowledge
3.	List any two types of electric energy storage.	CO3	BTL1	Knowledge
4.	What is the need for energy storage in renewable systems?	CO3	BTL2	Understand
5.	Define electrochemical energy storage.	CO3	BTL1	Knowledge
6.	What is Sodium–Sulfur (NaS) battery?	CO3	BTL1	Knowledge
7.	Mention one advantage of NaS battery.	CO3	BTL2	Understand
8.	What is wind energy integration?	CO3	BTL1	Knowledge
9.	Define Electric Vehicle (EV).	CO3	BTL1	Knowledge
10.	What is Vehicle-to-Grid (V2G)?	CO3	BTL1	Knowledge
11.	What is V2G capacity estimation?	CO3	BTL2	Understand
12.	Define smart grid.	CO3	BTL1	Knowledge
13.	Mention two features of smart grid.	CO3	BTL1	Knowledge
14.	What is distributed generation?	CO3	BTL1	Knowledge
15.	What is demand response in smart grid?	CO3	BTL2	Understand
16.	Define smart metering.	CO3	BTL1	Knowledge
17.	What is grid stability?	CO3	BTL1	Knowledge
18.	Mention two smart grid solutions.	CO3	BTL1	Knowledge
19.	What is load balancing?	CO3	BTL2	Understand
20.	What is renewable penetration?	CO3	BTL1	Knowledge
21.	Define microgrid.	CO3	BTL1	Knowledge
22.	What is peak shaving?	CO3	BTL2	Understand
23.	Mention two design challenges of smart grid.	CO3	BTL2	Understand
24.	What is the role of Industry 4.0 in smart grid?	CO3	BTL2	Understand
PART – B				
1.	Explain the role of energy storage in mitigating renewable energy variability. **(16)**	CO3	BTL3	Apply
2.	Discuss different types of electric energy storage systems. **(16)**	CO3	BTL3	Apply
3.	Analyze the working principle and advantages of Sodium–Sulfur battery. **(16)**	CO3	BTL4	Analyze
4.	Explain the integration of wind energy using NaS battery with a case study. **(16)**	CO3	BTL4	Analyze
5.	Describe Electric Vehicles as energy storage systems. **(16)**	CO3	BTL3	Apply
6.	Explain Vehicle-to-Grid (V2G) concept and capacity estimation. **(16)**	CO3	BTL3	Apply
7.	Discuss the definition, development, and architecture of smart grid. **(16)**	CO3	BTL3	Apply
8.	Explain smart grid components and their functions. **(16)**	CO3	BTL3	Apply
9.	Analyze smart grid solutions for efficient power management. **(16)**	CO3	BTL4	Analyze
10.	Discuss design challenges of smart grid. **(16)**	CO3	BTL4	Analyze

11.	Analyze the role of Industry 4.0 technologies in smart grid. **(16)**	CO3	BTL4	Analyze
12.	Evaluate the benefits of smart grid for sustainable energy systems. **(16)**	CO3	BTL5	Evaluate
13.	Evaluate challenges in large-scale integration of EVs into smart grid. **(16)**	CO3	BTL5	Evaluate
14.	Propose an energy storage solution for renewable integration. **(16)**	CO3	BTL6	Create
15.	Design a conceptual smart grid model incorporating renewable sources. **(16)**	CO3	BTL6	Create
16.	Develop a V2G-based energy management framework. **(16)**	CO3	BTL6	Create
17.	Justify the importance of smart energy systems in Industry 4.0. **(16)**	CO3	BTL5	Evaluate

UNIT IV- DESIGN OF SMART VEHICLE

Definition of Smart Vehicles, Evolution of Smart Vehicles, Components of Smart vehicle, Key Features of Smart Vehicles -Autonomous driving capabilities - Advanced driver-assistance systems (ADAS) - Vehicle-to-everything (V2X) communication - Real-time monitoring and data Analyze - Enhanced fuel efficiency and environmental sustainability, Control systems, communication system, Energy Management. Software and Hardware and testing modules- Safety measures.

PART – A

S.No	Questions	CO's	BTL Level	Competence
1.	Define smart vehicle.	CO4	BTL1	Knowledge
2.	What is meant by evolution of smart vehicles?	CO4	BTL1	Knowledge
3.	List the main components of a smart vehicle.	CO4	BTL1	Knowledge
4.	What is autonomous driving?	CO4	BTL1	Knowledge
5.	Define Advanced Driver Assistance Systems (ADAS).	CO4	BTL1	Knowledge
6.	What is V2X communication?	CO4	BTL1	Knowledge
7.	What is real-time monitoring in smart vehicles?	CO4	BTL2	Understand
8.	Define vehicle data analytics.	CO4	BTL1	Knowledge
9.	What is fuel efficiency?	CO4	BTL1	Knowledge
10.	How do smart vehicles support environmental sustainability?	CO4	BTL2	Understand
11.	What is a vehicle control system?	CO4	BTL1	Knowledge
12.	What is energy management system in vehicles?	CO4	BTL1	Knowledge
13.	Name any two sensors used in smart vehicles.	CO4	BTL1	Knowledge
14.	What is communication system in smart vehicles?	CO4	BTL2	Understand
15.	What is Electronic Control Unit (ECU)?	CO4	BTL1	Knowledge
16.	Define embedded software in vehicles.	CO4	BTL1	Knowledge
17.	What is automotive hardware module?	CO4	BTL1	Knowledge
18.	What is testing module in smart vehicles?	CO4	BTL1	Knowledge
19.	What is Hardware-in-the-Loop (HIL) testing?	CO4	BTL1	Knowledge
20.	What is software validation?	CO4	BTL1	Knowledge
21.	Define functional safety.	CO4	BTL1	Knowledge

22.	What is fail-safe mechanism?	CO4	BTL1	Knowledge
23.	Mention two safety measures in smart vehicles.	CO4	BTL2	Understand
24.	What is cybersecurity in smart vehicles?	CO4	BTL1	Knowledge
PART B				
1.	Explain the evolution of smart vehicles with suitable examples. **(16)**	CO4	BTL3	Apply
2.	Describe the architecture and components of a smart vehicle. **(16)**	CO4	BTL3	Apply
3.	Discuss key features of smart vehicles in detail. **(16)**	CO4	BTL3	Apply
4.	Analyze autonomous driving capabilities and their challenges. **(16)**	CO4	BTL4	Analyze
5.	Explain Advanced Driver Assistance Systems (ADAS) with Applys. **(16)**	CO4	BTL3	Apply
6.	Analyze the role of V2X communication in smart vehicles. **(16)**	CO4	BTL4	Analyze
7.	Explain real-time monitoring and data analytics in smart vehicles. **(16)**	CO4	BTL3	Apply
8.	Discuss control systems used in smart vehicles. **(16)**	CO4	BTL3	Apply
9.	Explain communication systems in smart vehicles. **(16)**	CO4	BTL3	Apply
10.	Describe energy management systems in smart vehicles. **(16)**	CO4	BTL3	Apply
11.	Analyze software architecture used in smart vehicles. **(16)**	CO4	BTL4	Analyze
12.	Analyze hardware modules and sensor integration in smart vehicles. **(16)**	CO4	BTL4	Analyze
13.	Explain testing and validation methods for smart vehicles. **(16)**	CO4	BTL3	Apply
14.	Evaluate safety measures and functional safety standards in smart vehicles. **(16)**	CO4	BTL5	Evaluate
15.	Evaluate challenges in designing autonomous smart vehicles. **(16)**	CO4	BTL5	Evaluate
16.	Design a conceptual smart vehicle system architecture. **(16)**	CO4	BTL6	Create
17.	Propose a smart vehicle solution for sustainable transportation. **(16)**	CO4	BTL6	Create

UNIT V- SMART APPLYS

Applys of UAVs in Industries. Understand Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars Case study - I : Milk Processing and Packaging Industries, Case study - II: Manufacturing Industries - Case study III - Virtual Reality Lab.

PART – A

S.No	Questions	CO's	BTL Level	Competence
1.	Define Unmanned Aerial Vehicle (UAV).	CO5	BTL1	Knowledge
2.	Mention two industrial Applys of UAVs.	CO5	BTL1	Knowledge
3.	What is UAV-based inspection?	CO5	BTL1	Knowledge
4.	Define smart appliances.	CO5	BTL1	Knowledge
5.	What is smart operation in appliances?	CO5	BTL1	Knowledge

6.	What is smart monitoring?	CO5	BTL1	Knowledge
7.	Define smart energy savings.	CO5	BTL2	Understand
8.	What is smart maintenance?	CO5	BTL1	Knowledge
9.	Mention two features of smart appliances.	CO5	BTL1	Knowledge
10.	What is IoT-based appliance control?	CO5	BTL2	Understand
11.	What is predictive maintenance?	CO5	BTL1	Knowledge
12.	Define smart car.	CO5	BTL1	Knowledge
13.	Mention two Applys of smart cars.	CO5	BTL1	Knowledge
14.	What is fleet management?	CO5	BTL1	Knowledge
15.	What is real-time data collection?	CO5	BTL1	Knowledge
16.	Define smart manufacturing Apply.	CO5	BTL1	Knowledge
17.	What is milk processing automation?	CO5	BTL1	Knowledge
18.	What is smart packaging?	CO5	BTL1	Knowledge
19.	What is quality monitoring?	CO5	BTL2	Understand
20.	Define manufacturing execution system (MES).	CO5	BTL1	Knowledge
21.	What is Virtual Reality (VR)?	CO5	BTL1	Knowledge
22.	What is a virtual reality lab?	CO5	BTL1	Knowledge
23.	What is immersive learning?	CO5	BTL2	Understand
24.	What is data-driven decision making?	CO5	BTL2	Understand
	PART B			
1.	Explain the Applys of UAVs in industrial sectors. **(16)**	CO5	BTL3	Apply
2.	Discuss UAV-based monitoring and inspection systems. **(16)**	CO5	BTL3	Apply
3.	Explain the concept and working of smart appliances. **(16)**	CO5	BTL3	Apply
4.	Analyze smart operation and smart monitoring in appliances. **(16)**	CO5	BTL4	Analyze
5.	Discuss smart energy saving techniques used in smart appliances. **(16)**	CO5	BTL3	Apply
6.	Explain smart maintenance and predictive maintenance systems. **(16)**	CO5	BTL3	Apply
7.	Discuss smart car technologies with suitable examples. **(16)**	CO5	BTL3	Apply
8.	Analyze the role of smart cars in intelligent transportation systems. **(16)**	CO5	BTL4	Analyze
9.	Explain the milk processing and packaging industry case study using smart Applys. **(16)**	CO5	BTL3	Apply
10.	Analyze smart manufacturing Applys in manufacturing industries – case study. **(16)**	CO5	BTL4	Analyze
11.	Explain the role of automation and IoT in manufacturing industries. **(16)**	CO5	BTL3	Apply
12.	Discuss the benefits of smart Applys in industrial productivity. **(16)**	CO5	BTL3	Apply
13.	Evaluate challenges in implementing smart Applys in industries. **(16)**	CO5	BTL5	Evaluate

14.	Evaluate the effectiveness of smart cars for sustainable transportation. **(16)**	CO5	BTL5	Evaluate
15.	Explain the concept of Virtual Reality lab with Applys. **(16)**	CO5	BTL3	Apply
16.	Analyze the role of Virtual Reality labs in industrial training. **(16)**	CO5	BTL4	Analyze
17.	Design a smart Apply model using Industry 4.0 technologies. **(16)**	CO5	BTL6	Create