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Register No: …… Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION(R), MAY 2024

Robotics and Automation

(2020 SCHEME)

Course Code : 20RBT454

Course Name : Industry 4.0

Max. Marks : 100 **Duration:3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Describe the role of digital twin in predictive maintainance industry?
2. List any six features of Industry 4.0?
3. What are Cyber-Physical Systems (CPS) applications in manufacturing? Provide three examples.
4. Evaluate the effectiveness of feedback control systems in regulating Cyber-Physical Systems. Discuss three benefits of using feedback loops for control in CPS.
5. Identify the ways in which intelligent workpieces enhance process efficiency in Industry 4.0?
6. Enlist and brief about any three communication protocols used for exchanging data between workpieces and machines.
7. Compare and contrast the characteristics of predictive digital twins and reactive digital twins. Explain how each type operates and provide examples of their applications in different industries.
8. Imagine you are designing a digital twin for a renewable energy generation system, such as a wind farm. Explain how the digital twin could be used to predict and optimize power output based on weather forecasts and historical performance data. Provide examples of how the digital twin model would simulate different operating scenarios and recommend adjustments for maximizing energy production.
9. Define manipulator systems and their role in industrial automation. Give three examples of tasks that manipulator systems can perform in manufacturing
10. Explain the role of mobile information technologies in facilitating real-time communication in industrial environments. Give three examples of mobile communication tools used by workers on the shop floor.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Analyse the impact of Industry 4.0 on workforce skills and job roles, addressing both opportunities and challenges. 7
    b) Explain how digital supply chain management is transformed in Industry 4.0, highlighting the role of IoT and cloud computing. 7

OR

12. a) Compare and contrast traditional manufacturing with cloud manufacturing, highlighting the benefits and challenges of adopting cloud-based technologies in the manufacturing . 7
    b) Evaluate the potential risks and benefits of integrating cyber-physical systems in manufacturing processes under Industry 4.0. 7

MODULE II

13.	a) Evaluate the role of communication protocols in ensuring interoperability in Cyber-Physical Systems. Discuss three challenges associated with interoperability in CPS communication and strategies to address them.	7
	b) Analyze the impact of design methodologies on CPS development lifecycle. Discuss three factors that influence the selection of design methods for CPS projects and their implications on project outcomes.	7
	OR	
14.	a) Critically assess the role of Cyber-Physical Systems in revolutionizing healthcare delivery. Provide three case studies highlighting the integration of CPS in medical devices, telemedicine, and patient monitoring systems, and discuss the impact on patient care and outcomes.	7
	b) Compare and contrast traditional manufacturing processes with Cyber-Physical Systems-enabled smart manufacturing. Discuss three key differences and advantages of adopting CPS in manufacturing.	7
	MODULE III	
15.	a) Compare and contrast the advantages and limitations of QR codes and RFID technology for workpiece tagging, considering factors such as cost, range, and data capacity.	7
	b) How does work piece tagging contribute to quality control processes in manufacturing, and what benefits does it offer in terms of product consistency and reliability?	7
	OR	
16.	a) How can smart work pieces contribute to achieving greater efficiency and flexibility in production systems?	7
	b) Analyze the potential impact of multi-agent systems on optimizing production processes in Industry 4.0 environments.	7
	MODULE IV	
17.	a) Evaluate the significance of virtual twins in digital transformation initiatives across various industries. Discuss how virtual twins facilitate innovation, experimentation, and risk mitigation in product development, operational planning, and customer engagement strategies.	7
	b) Examine the applications of predictive digital twins and reactive digital twins in predictive maintenance strategies for industrial equipment. Discuss how predictive digital twins use historical data and machine learning algorithms to forecast equipment failures and optimize maintenance schedules. Compare this with reactive digital twins, which trigger alerts and responses based on real-time sensor data.	7
	OR	
18.	a) Examine the applications of digital twins in improving workforce productivity and safety in manufacturing. Provide seven examples of how digital twins support training, workflow optimization, and safety protocols for factory workers.	7
	b) Evaluate the impact of digital twins on reducing downtime and increasing overall equipment effectiveness (OEE) in production operations. Discuss seven strategies and tools enabled by digital twins that enhance equipment reliability, maintenance efficiency, and performance monitoring.	7
	MODULE V	
19.	a) Evaluate the social and economic implications of inaccessible workplaces in production environments, considering factors such as employee satisfaction, turnover rates, and organizational reputation. Enlist three potential consequences of failing to address accessibility barriers and provide recommendations for organizations to promote inclusivity and diversity in the workforce.	7
	b) Analyze the role of universal design principles in creating barrier-free workplaces that accommodate the needs of all employees, regardless of age, ability, or mobility. Provide three examples of how universal design concepts, such as adjustable workstations, clear signage, and colour-contrast flooring, can improve accessibility and enhance the overall work environment in production facilities.	7
	OR	
20.	a) Critically analyze the ethical considerations surrounding the use of AI-driven technologies to monitor and manage the connected worker in Industry 4.0 settings. Explore issues such as algorithmic bias, privacy infringements, and job displacement, and assess the implications for individual rights, social justice, and organizational responsibility.	7
	b) Identify how IoT-enabled sensors, smart energy management systems, and data analytics	

contribute to resource efficiency, waste reduction, and carbon footprint mitigation. Evaluate the potential of connected workers to promote eco-friendly practices, foster a culture of environmental stewardship, and support corporate sustainability goals in manufacturing and industrial settings.

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