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Question Paper Code: U9779

B.E. / B.Tech. DEGREE EXAMINATION, APRIL/MAY 2025

Open Elective

Mechanical Engineering

21UME979 - ROBOTICS

(Regulations 2021)

(Common to all Engineering Branches)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. What is the primary function of a robot? CO1- U
 - a) Thinking like humans
 - b) Performing tasks automatically
 - c) Communicating emotion
 - d) Learning languages
2. A key reason for using robots in healthcare is: CO1-U
 - a) Reducing human interaction
 - b) Improving precision in surgeries
 - c) Reducing medical costs
 - d) Eliminating human doctors
3. A serial manipulator consists of: CO1- U
 - a) Links connected in a closed loop
 - b) Links connected end-to-end
 - c) Multiple end-effectors
 - d) Rotating platforms
4. Pneumatic grippers are commonly used for: CO1- U
 - a) High-load applications
 - b) Low-weight, high-speed operations
 - c) Complex assembly tasks
 - d) Welding applications
5. Servo motors operate using: CO1- U
 - a) Open-loop control
 - b) Closed-loop control
 - c) No control system
 - d) Hydraulic pressure

6. A tactile sensor is designed to measure: CO1- U
 a) Light intensity b) Surface contact and force
 c) Sound waves d) Air pressure
7. A disadvantage of mobile robots is: CO1- U
 a) High energy consumption b) Inability to adapt
 c) Requires manual programming for all tasks d) Limited applications in industries
8. The brain of the mobile robot, which processes sensor data and controls movement, is: CO1- U
 a) Battery b) Actuator c) Controller d) Motor
9. Which type of robot is used for performing surgeries in the medical field? CO1- U
 a) Autonomous Mobile Robot (AMR) b) Articulated Robot
 c) Surgical Robot d) Humanoid Robot
10. What is one safety consideration when using robots for welding? CO1- U
 a) Ensuring the robot moves at maximum speed to complete tasks quickly
 b) Using proper shielding to protect workers from sparks, heat, and UV radiation
 c) Disabling all sensors to prevent unnecessary interruptions during operation
 d) Allowing human workers to manually adjust the welding torch while the robot is active

PART – B (5 x 2= 10 Marks)

11. Define degrees of freedom (DOF) in robots CO1- U
12. Differentiate between open-loop and closed-loop control systems. CO1 - U
13. Why are sensors essential in robotics? CO3-App
14. What is Kuri Robot, and what is its purpose? CO2-App
15. Describe the application of robots in packaging. CO1 - U

PART – C (5 x 16= 80 Marks)

16. (a) If you were to design a robot for an industrial assembly line, how would you select and integrate its key components (actuators, sensors, controllers, etc.) to optimize performance? CO2 -App (16)
- Or
- (b) If a robot needs to operate in a high-temperature foundry, what changes would you make to its structure and components to ensure durability? CO2 -App (16)

17. (a) Design a robotic end effector for a collaborative environment with humans, and explain the specific safety features you would incorporate to minimize risks and ensure safe interaction. CO2- App (16)
- Or
- (b) Given the requirements of high precision in surgical robotics, apply your knowledge of robotic gripper design to identify and justify the key design considerations necessary for ensuring accuracy, safety, and functionality in such applications. CO3 -App (16)
18. (a) A robotic arm is required to perform pick-and-place operations with high positional accuracy. Design a motion control system using stepper motors, considering factors such as step resolution, torque requirements, and controller selection CO3 -App (16)
- Or
- (b) A warehouse robot is required to transport loads up to 200 kg across a large facility with smooth and slightly inclined surfaces. Apply engineering principles to select the most suitable drive system and justify your choice. CO3- App (16)
19. (a) Design a mobile robot for exploring an underwater environment. Based on the classification of mobile robots, choose the most appropriate type (e.g., wheeled, tracked, or aquatic robot) for underwater exploration. Justify your choice by discussing the unique challenges of underwater locomotion such as water resistance, buoyancy control, pressure, and limited visibility. CO4 -App (16)
- Or
- (b) Design a robotic delivery solution for autonomous parcel delivery in a smart city. Explain how the robot will interact with urban infrastructure, navigate sidewalks, and use communication systems for efficient delivery. Discuss how the system will handle dynamic traffic conditions, parking areas, and ensure the safety of pedestrians. CO4 -App (16)
20. (a) Develop an industrial robot for 3D printing of large-scale components in the aerospace industry. Explain how the robot will position and deposit materials to build complex parts. Discuss how the robot will ensure accuracy, stability, and quality in high-precision 3D printing tasks, and how it will interact with existing manufacturing systems. CO4 -App (16)

Or

- (b) Given the requirements of high precision in surgical robotics, CO4 -App (16) apply your knowledge of robotic gripper design to identify and justify the key design considerations necessary for ensuring accuracy, safety, and functionality in such applications.