Exam Date & Time: 02-Dec-2023 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

MIT MPL and BLR - BTech I-III-V and VII Semester - End Semester Examination - Nov-Dec 2023

INDUSTRIAL AUTOMATION AND ROBOTICS [MIE 2130]

Marks: 50   **Duration: 180 mins.**

Descriptive

Answer all the questions.

* Assume the missing data suitably.
* Write neatly and legibly.

1)   Explain the functions of pneumatic system components that enable a controlled motion in assembly lines or lifting in material handling systems.   (4)

2)   Describe the role and significance of a lubricator within a pneumatic system. Explain its function in maintaining pneumatic components, detailing how it ensures proper operation and impacts system efficiency and longevity.   (3)

3)   List five distinct advantages and limitations of pneumatic systems in industrial applications.   (3)

4)   List the components and functionalities and the role of essential accessories in enhancing the performance and safety of a hydraulic power pack.   (5)

5)   Discuss how Pascal's law applies to hydraulic systems and its significance in the transmission of fluid pressure.   (3)

6)   Describe how force is transmitted within hydraulic systems, highlighting the key mechanisms and their operational significance.   (2)

7)   Discuss the operational principles and industrial applications of hydraulic systems. List three advantages and limitations of gear pumps, vane pumps, and piston pumps.   (4)

8)   In a hydraulic system of the forklift for material handling, identify and explain the valve type that is used to enable essential tasks like raising and lowering the forks.   (4)

9)   Differentiate between automation and robotics, emphasizing their respective roles in industrial processes.   (2)

10)   An industrial scenario requires precise, linear movements in a confined space and another scenario demands versatile, multi-angle motions. Justify the selection of robot configurations for each scenario, outlining the advantages of the chosen type.   (4)

11)   Explain the role of actuators in a robot's drive system and discuss the importance of transmission mechanisms in facilitating diverse robotic motions.   (3)

12)   A mechanical gripper is designed to securely hold a part weighing 65 N with a coefficient of friction (μ) of 0.3 between the part and its jaws. The gripper's configuration includes length measurements: l_1=55mm; l_2=50mm; l_3=20mm; l_4=60mm. The pneumatic cylinder actuating the gripper has a diameter of 80 mm. Apply a Factor of Safety (FoS) of 1.8.

      a) Calculate the total force required by the gripper to securely retain the part considering its weight and friction.

      b) Determine the actuation force needed to achieve the grasping force considering the gripper's mechanical advantage.   (3)

      c) Calculate the pressure required to operate the pneumatic piston, ensuring successful gripper actuation.

      d) Determine the power consumption if the pneumatic system's air discharge rate is 0.015 m³/s.

13)   Discuss how force analysis in mechanical grippers influences their selection and performance in robotic handling tasks, emphasizing its significance in diverse applications.   (5)

14)   Identify and discuss the commonly used type of sensor that provides information about the shape of the object.   (2)

15)   In an automated manufacturing setup to handle ferromagnetic material, justify your choice for a particular gripper based on each type's unique advantages.   (3)

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