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Question Paper Code : 82336

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fourth Semester

Mechanical Engineering

ME 3492 — HYDRAULICS AND PNEUMATICS

(Common to: Mechanical Engineering (Sandwich))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Compare the use of fluid power to a mechanical system by listing the advantages and disadvantages of each.
2. Distinguish between positive displacement and dynamic (nonpositive displacement) pumps.
3. Define hydraulic cushioning in cylinders.
4. Differentiate between flow control and pressure control valves.
5. Mention one application of a pressure intensifier circuit.
6. What is a fail-safe circuit?
7. Why is a lubricator used in pneumatic systems?
8. State the function of a timer circuit in electro-pneumatic control.
9. What are two important factors to consider during the installation of a hydraulic system?
10. What is the role of IOT in modern hydraulic systems?

PART B — ($5 \times 13 = 65$ marks)

11. (a) Describe the construction and working of a variable displacement, pressure-compensated vane pump with a neat diagram. Explain its main applications and advantages over fixed displacement pumps.

Or

- (b) A pump has a displacement volume of 100 cm^3 . It delivers $0.0015 \text{ m}^3/\text{s}$ at 1000 rpm and 70 bars. If the prime mover input torque is 120 Nm.
- What is the overall efficiency of the pump?
 - What is the theoretical torque required to operate the pump?
12. (a) Describe the construction and working of a bent-axis type axial piston motor with a neat diagram. Mention its advantages and applications.

Or

- (b) A pressure relief valve contains a poppet with a 4.20 cm^2 area on which system pressure acts. During assembly a spring with a spring constant of 3200 N/cm is installed in the valve to hold the poppet against its seat. The adjustment mechanism is then set so that the spring is initially compressed 0.50 cm from its free-length condition. In order to pass full pump flow through the valve at the PRV pressure setting, the poppet must move 0.30 cm from its fully closed position. Determine the (i) Cracking pressure (ii) Full pump flow pressure (PRV pressure setting)
13. (a) Explain the methods used for cylinder synchronization in hydraulic systems, with neat diagrams. Also, provide industrial applications.

Or

- (b) Explain electro-hydraulic circuits with a suitable industrial example. Include a circuit diagram, list the main components, and mention the advantages.
14. (a) Design a multi-cylinder hydraulic circuit using the Cascade method for the following sequence: $A + B + C + C - A - B -$. Explain the working of the circuit, draw the schematic diagram, and describe how the Cascade method ensures proper sequencing.

Or

- (b) Write a ladder program where motor M starts 10 seconds after button S is pressed. S must be pressed 4 times before M turns OFF automatically. After M turns OFF, there should be a 20-second lockout before S can affect the system again.
15. (a) Design a hydraulic circuit for a shaping machine with forward and return strokes. Draw the diagram and explain how it works. Mention the main components and their functions.

Or

- (b) Create the PLC logic and design the pneumatic circuit for a metalworking station. When the start button is pressed, metal parts are moved into position via a conveyor. When a photoelectric sensor detects a part, the conveyor should stop, a press should activate for 4 seconds to perform the operation, and then the conveyor should restart. Include start/stop controls and a lamp that indicates when the system is active.

PART C — (1 × 15 = 15 marks)

16. (a) Explain the working principles of hydraulic servo systems. Discuss their components, including the servo valve, actuator, and controller. Provide examples of industrial applications.

Or

- (b) Write the ladder logic diagram for a pneumatic cylinder used in a process. The cylinder may become stuck, so this condition needs to be detected. Proximity sensors are installed at both ends of the cylinder's stroke to indicate when it has reached the end positions. If the cylinder takes more than 2 seconds to complete its motion, it should be considered a fault. When this occurs, the machine must shut down, and a warning light should turn on. Develop ladder logic that continuously cycles the cylinder in and out while monitoring for any failure.
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