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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth/Sixth Semester

Mechanical Engineering

ME 8694 — HYDRAULICS AND PNEUMATICS

(Common to : Manufacturing Engineering/Mechanical Engineering (Sandwich)/Robotics and Automation)

(Regulations 2017)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between hydraulic and pneumatic power sources with respect to payload, accuracy, speed control and maintenance.

2. A van of 16,000N is to be lifted using a hydraulic lift as shown in Fig 2. Determine the force required to lift the van if areas A_A = 0.005 m^2 and A_B = 0.4 m^2.
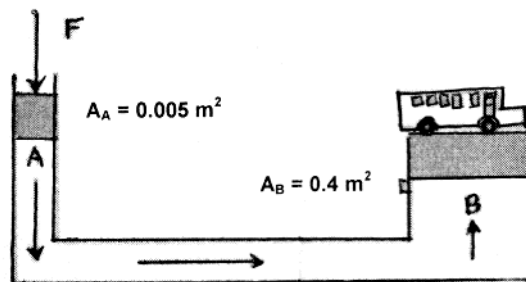

Fig. 2 Hydraulic lift

3. 'Pressure relief valve is essential in all hydraulic systems' – Justify.

4. Sketch the ISO symbols of the following fluid elements:

    (a) Shuttle valve

    (b) Double rod end cylinder.

5. List any four advantages of air-over oil systems.

6. A hydraulic platform used to lift cars requires synchronous motion of two hydraulic cylinders. Sketch a circuit for synchronous movement of the two hydraulic cylinders.

7. Develop ladder logic diagrams illustrating 'OR' logic and 'NOT' logic.

8. What are fluidics? State its significance in logic circuits.

9. State the importance of proper troubleshootting of hydraulic systems.

10. Why are pneumatic systems preferred for tool handing in machine tools?

PART B — (5 × 13 = 65 marks)

11. (a) (i) With a neat sketch, explain the working principle of a swash plate axial piston pump and mention how the displacement can be varied. (7)

 (ii) Explain any five desirable properties of hydraulic fluids. (6)

Or

 (b) (i) The system shown in Fig 11(b)(i) contains a hydraulic pump delivering high pressure oil of specific gravity 0.9 and kinematic viscosity 1.25×10^{-4} m²/s, to a hydraulic motor. A 25 m pipe of internal diameter 30 mm and thickness of 10 mm connects the pump and motor. The pipe has two elbow fittings (k=0.70) and one check valve (k=4.0). The motor is placed 10 m above the pump. The pressure required to drive the loaded motor is 40 bar. Determine the pump discharge pressure, if the discharge from the pump is 180 Ipm. (10)
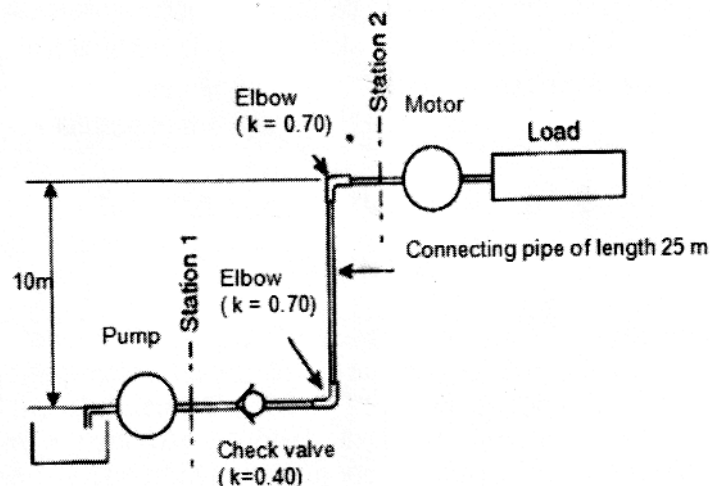

Fig. 11(b)(i) Hydraulic system

 (ii) Discuss the factors to be considered in selection of a linear actuator for an industrial application. (3)

12. (a) (i) Illustrate the working of a Sequencing valve. (7)

   (ii) Explain the working of a proportional pressure relief valve. (6)

Or

   (b) (i) With a neat sketch, brief on cushioning in hydraulic cylinders. (7)

   (ii) With the aid of neat sketches, describe meter-in and meter-out hydraulic circuits and state their significance. (6)

13. (a) (i) An industry is interested in developing a hydraulic drilling machine to drill 10mm thick steel plates. Since, the cycle time of the process has to be minimum, faster approach and retraction strokes are essential. A power pack with a single pump system is already available with the industry and hence the same is proposed to be used. As an automation engineer,

   (1) Develop an appropriate circuit to achieve the above objectives. (4)

   (2) Justify that the extension velocity is faster than the conventional hydraulic circuit. (3)

   (ii) Explain the fail-safe circuit with suitable sketches. (6)

Or

   (b) (i) 'Accumulators act as shock suppressors' – justify using an example. (7)

   (ii) Illustrate the significance of an unloading valve in a double-pump hydraulic system. (6)

14. (a) (i) Illustrate the working of a lubricator in a pneumatic system. (7)

   (ii) Brief on the working of 3/2 solenoid operated spring return valve. (6)

Or

   (b) (i) Brief on the working of any one type of positive displacement compressor. (7)

   (ii) Citing an industrial example, Illustrate the working of a quick exhaust valve. (6)

15. (a) Sketch a hydraulic circuit used for the operation of a surface grinder and explain the same. (13)

Or

   (b) (i) A pump is delivering insufficient oil to the system. State any three possible causes and remedial actions. (6)

   (ii) Sketch a typical reservoir used in a stationary hydraulic machine and discuss the functions of reservoir in the system. (7)

PART C — (1 × 15 = 15 marks)

16. (a) A system is required to control the speed of a hydraulic vane motor operating a winch, to a very precise tolerance. The flow rate of oil to the vane motor is dependent on the displacement of the pump (pump output), which is controlled by the position of a hydraulic cylinder. In short, the displacement of the motor depends on the position of hydraulic cylinder. The speed of the winch is monitored by an electronic sensor and the output signals of the sensor have to act as input for a servo valve, which in turn decides the position of hydraulic cylinder. Suggest a suitable servo valve for the above application and explain its working principle.

Or

(b) Grooves are to be cut in wooden frames on a shaper (Fig 16b). The wooden frame is to be clamped with a pneumatic cylinder-A as shown in Fig 16b. The feed of the shaper table is carried out by a pneumatic feed unit (cylinder-B). After the groove is cut, the shaper table retracts back, and is followed by unclamping. The strokes of cylinders are confirmed by limit switches a_0, a_1, b_0 and b_1. Design a pneumatic circuit for the above sequence of operations using Cascade method. The cycle has to start only if a start button is pressed by an operator.
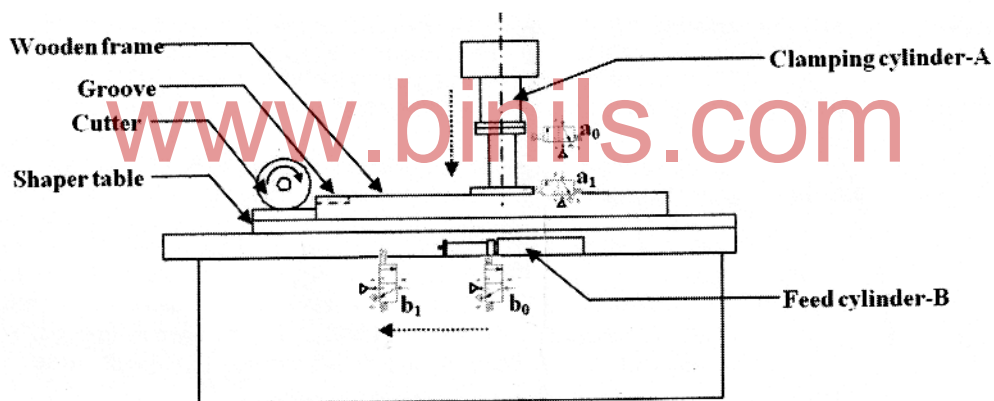

Fig. 16(b) Wooden Shaper

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