



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: January 2022

Module Number: ME6205

Module Name: Power Hydraulics

[Three Hours]

[Answer all questions, each question carries twelve marks]

Q1.

- (a) Fluid power applications are extensively used in several industries. List six industries and explain how Fluid Power Systems are applicable for each industry. [3.0 Marks]
- (b) What are the advantages and disadvantages of a Fluid Power System? [2.0 Marks]
- (c) What are the safety precautions that should be taken during the operation and maintenance of power hydraulic systems? [2.0 Marks]
- (d) Figure Q1 (d) shows the major components of a Fluid Power System. Briefly explain the basic functions of each components in the system. [2.0 Marks]

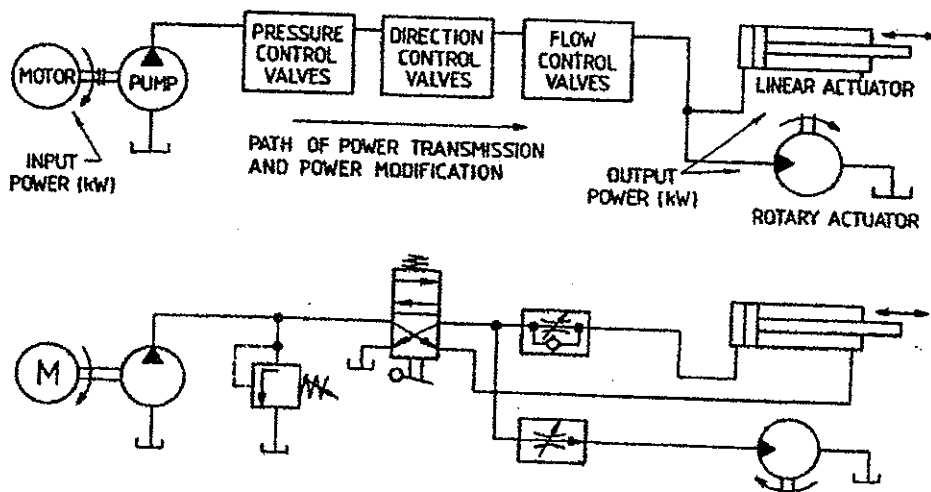


Figure Q1 (d)

[5.0 Marks]

Q2.

- (a) What does it mean by the term "3/4 Directional Control Valve (DCV)"? [2.0 Marks]
- (b) List five different methods used to actuate DCVs. [2.0 Marks]

- (c) What are the specific devices used to control the flow in hydraulic circuits? Provide the working mechanism of one with a diagram. [2.0 Marks]
- (d) The hydraulic reservoir acts as a storage vessel for the fluid in a power hydraulic system. List three other functions of a reservoir. [3.0 Marks]
- (f) The sectional view of a reservoir is shown in Figure Q3 (d). Name the parts indicated on the reservoir.

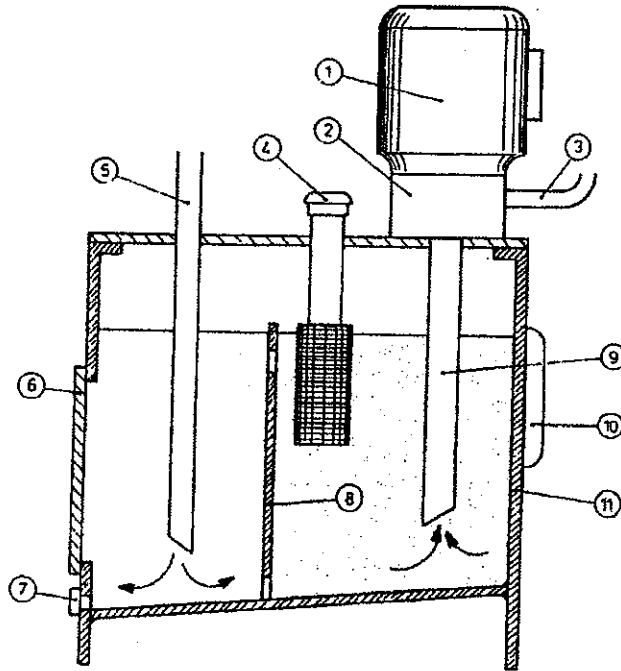


Figure Q2 (f)

[3.0 Marks]

Q3.

- (a) State the names of the positive displacement pumps shown below (Figure Q3 (a)). and explain briefly how they produce high pressure while functioning.

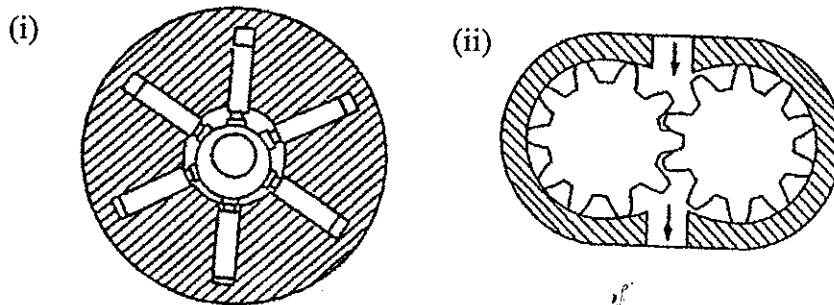


Figure Q3 (a)

[4.0 Marks]

(b) A Fluid Power System consists of a Variable Capacity Pump (VCP) and a Fixed Capacity Motor (FCM). Explain with clear graphs the following characteristics of the system,

- (i) Speed of the FCM with capacity of the VCP
- (ii) Torque and power of the FCM with the speed
- (iii) Pressure variation at the relief valve and the FCM with a constant power load.

[4.0 Marks]

(c) In a Fluid Power System, physical and chemical properties of hydraulic oil should be maintained at a permissible conditions irrespective of the pressure, temperature and operating time. List the required properties of a hydraulic oil used in a Fluid Power System and explain three of them in details.

[4.0 Marks]

Q4. A Fluid Power System has a Variable Capacity Pump (VCP) and a Fixed Capacity Motor (FCM). The VCP supplies oil to the FCM which is coupled to a constant power load. The maximum capacity of the VCP is 45 ml/rev and the capacity of the FCM is 30 ml/rev. The VCP is directly coupled to an electric motor and is driven at a constant speed of 1450 rpm. Hydraulic losses in pipes and fittings between the VCP and FCM are estimated to be equivalent to 2 bar. For both VCP and FCM the mechanical efficiency and volumetric efficiency are 80% and 90%, respectively.

- (i) Estimate relief valve setting to obtain a maximum torque of 7.5 Nm.
- (ii) At the relief valve pressure in Q4 (b) (i) what should be the speed range associated with a constant power load of 600W
- (iii) At the same constant power load of 600W, what should be the relief valve pressure to increase the speed range in Q4 (b) (ii) by 40%.

[12 Marks]

Q5. In a product manufacturing process, an automatic drilling operation is performed by a specially design machine which consists of two double-acting cylinders and two sequence valves. One cylinder is used as a clamp cylinder and other cylinder as a drill cylinder. At first, a clamp cylinder extends and clams a work piece. Then, a drill

cylinder extends to drive a spindle to drill a hole on the work piece. After drilling the drill cylinder retracts the drill spindle and then clamp cylinder retracts to release the work piece for removal. Design a hydraulic circuit to accomplish above operations with a suitable 4/3 DCV by facilitating automatic repetition of the operations.

[12 Marks]

