B.M.E. 3rd Year 2nd Semester Examination, 2017

Subject: Electrohydraulic Control Systems

Time : Three hours **Full Marks: 100**

Question No. 1 is compulsory *and Answer* ***two*** *questions from each of groups A and B.*

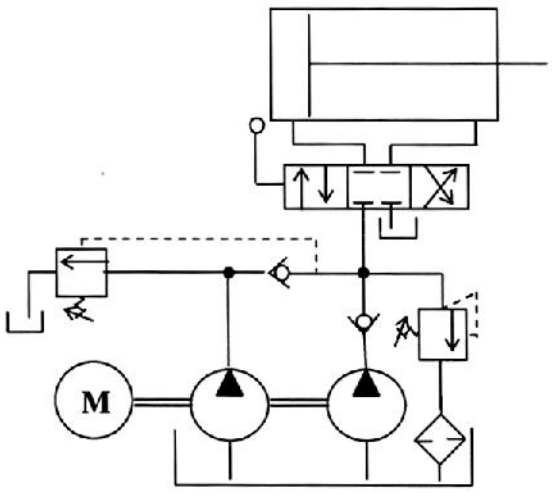
1. Justify the following statements: **[5×4]**
   (a) Positive displacements pumps are preferred over rotodynamic pumps in case of fluid power applications.
   (b) The same spool valve with metered ports, which is used in a circuit with a symmetric actuator, should not be used for the case of an asymmetric actuator.
   (c) An intensifier has four ports.
   (d) A regenerative circuit cannot be constructed with a symmetric actuator.

Group A

2. (a) A 95% efficient electric motor consumes 40 *kW* when driving a gear pump delivering 3 *l/s* at 10.0 *MPa* setting of the relief valve. This power is used to lift a mass of 15000 *kg* at a speed of 140 *mm/s* by an asymmetric actuator of 150 *mm* cylinder bore and 100 *mm* rod diameter. Friction accounts for a loss of 6.8% of external force to be lifted by the actuator. Consider the supply and return line of the actuator to be identical in all respect and the loss at the direction control valve during extension of the actuator to be negligible. Find the power losses in the motor, pump, and actuator along with those in the supply and return lines. Also find the cap-end and rod-end pressures of the actuator. **[12]**

   (b) Explain the operation of a variable displacement swash plate axial piston pump. **[08]**

3. (a) Explain explicitly every symbol of the circuit shown in the figure. Identify the circuit and explain its working principal. **[14]**



   (b) Discuss the role of an *accumulator* in a fluid power circuit. **[6]**

4. (a) Obtain an expression of efficiency for a meter-out circuit. Why is it preferred over meter-in and bleeder circuits? **[10]**

   (b) Briefly describe the operation of a sequence circuit, as used in a fluid power system, with the help of a neat sketch. **[10]**

Group B

5. (a) A system with transfer function $G(s) = s/(s^2+1)$ has a proportional controller of gain K=2 and unity feedback. Determine the closed-loop pole positions for $K = 2$. **[7]**

   (b) Using Final Value Theorem show that for constant demand, a P controller always shows steady state error, while an I controller has it as zero. **[10]**

   (c) State the relative advantage of a PI controller over an I controller. **[3]**

6. (a) For the system with transfer function $G(s) = (s+1)/(s^2+7s+10)$, what are the poles and zeroes? Explain which pole should be termed as dominant. **[3+3]**

   (b) For the above system draw the Bode plot. **[14]**

7. (a) Consider a hydraulic circuit comprising of a symmetric actuator under no external load and a solenoid operated servovalve. Design a position controller with both feedforward and feedback parts for the above system, where the position feedback is fed to the controller using an LVDT. **[15]**

   (b) Using Routh criteria find out the condition for stability of a 3rd order system. **[5]**