

B.M.E. 4th Year 1st Semester Supplementary Examination, 2017

Subject: Fluid Power & Control

Time : Three hours**Full Marks: 100****Question No. 1 is compulsory and answer two(2) questions from each of groups A and B.**

1. (a) What are the basic components of a fluid power system?
- (b) State Routh's criteria for stability.
- (c) Distinguish between under-lapped, critically-lapped and over-lapped spool valve.
- (d) What are the advantages of feedback control systems over open loop systems?

[6+4+6+4]**Group A**

2. (a) With a neat sketch, describe the operation of a counterbalance circuit.
- (b) Draw a circuit with valve connections in a manner such that an unequal area actuator could be operated with regeneration for the extension stroke. **[10+10]**
3. 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. Also find the cap-end and rod-end pressures of the actuator. **[20]**
4. (a) Describe the working of a swash plate type axial piston pump.
- (b) With neat sketch briefly describe the function of 3-position-4-way direction control valve. **[10+10]**

Group B

5. (a) For the transfer function, $G(s) = \frac{C(s)}{R(s)} = \frac{(s+3)}{(s+1)(s-2)}$, obtain system response to a unit step input of $r(t)$. What are the poles and zeroes? Comment on the stability of the plant.
- (b) Use the Routh's stability criterion to find out for what limit of K , the system with the following characteristic equation, is stable: $s^4 + s^3 + Ks^2 + 2s + 5 = 0$. **[12+08]**
6. Consider the case of a 3-landed spool valve driving a symmetric actuator. The spool valve ports are rectangular of equivalent width w_p , the discharge coefficient of the ports C_d , the fluid density ρ and the supply and return pressures P_P and P_T respectively. If the actuator load is negligible, the fluid is incompressible, obtain an expression for the valve flow gain and pressure coefficient. If the bore and rod diameters of the actuator are A_b and A_r , respectively, obtain the system transfer function, $G(s) = Y(s)/X(s)$, where $x(t)$ and $y(t)$ are the spool and actuator piston displacements respectively. Also sketch a block diagram of the system. **[20]**
7. Write short notes on any **four (4)** of the following:
 - (i) Dominant Pole; (ii) Pressure compensated flow control valve; (iii) Pressure reducing valve; (iv) Tandem-centered valve; (v) PID controller; (vi) System transfer function.

[4×5=20]