

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech(MTI)/SEM-1/MTI-105/2012-13**

**2012**

**FLUID DRIVES AND CONTROLS**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

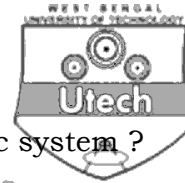
*Candidates are required to give their answers in their own words  
as far as practicable.*

Answer any *five* questions.

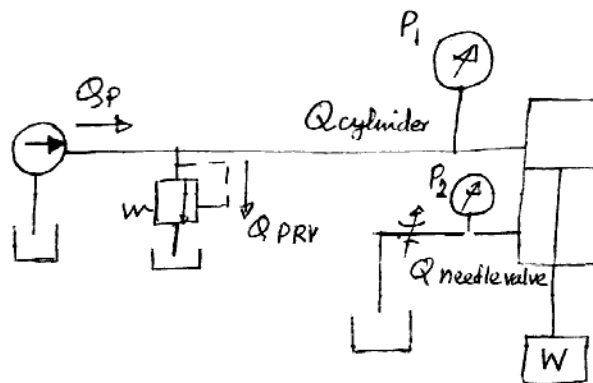
5 × 14 = 70

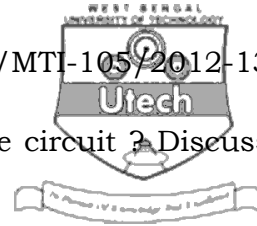
1. a) Relative to power there is an analogy between mechanical, electrical and hydraulic systems. State this analogy.
- b) Name the important considerations when selecting a pump for a particular operation. Discuss in brief.
- c) A hydraulic cylinder is to compress a car body down to bale size in 8 seconds. The operation requires a 3 metre stroke and a 40,000 N force. If a 10 MPa pump has been selected and assuming the cylinder is 100% efficient, find the
  - i) required piston area (m<sup>2</sup>)
  - ii) necessary pump flow rate (m<sup>3</sup>/s)
  - iii) hydraulic power (kW) delivered to the cylinder
  - iv) output power (kW) delivered by the cylinder to the load.

2 + 4 + 8

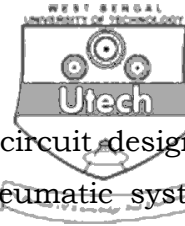


2.
  - a) How is pressure developed in a hydraulic system ?
  - b) Discuss the working principles of two basic types of piston pumps.
  - c) A pump has displacement volume of  $100 \text{ cm}^3/\text{rev}$ . It delivers  $0.0015 \text{ m}^3/\text{s}$  of oil at 1000 rpm and 70 bar. If the prime mover input torque is 120 N-m,
    - i) what is the overall efficiency of the pump ?
    - ii) what is the theoretical torque required to operate the pump ?
3.
  - a) What is cracking pressure ? How does a simple pressure valve and a pilot operated pressure relief valve differ in operation ? Discuss with suitable sketch.
  - b) How does a 3-piston 4 ways direction control valve can be classified based on various centre flow positions ?
  - c) The system of figure below has a hydraulic cylinder with a suspended load  $W$ . The cylinder piston and rod diameters are 5 cm and 2.5 cm respectively. The pressure relief valve setting is 50 bar. Determine pressure  $P_2$  for a constant cylinder speed if weight is 9000 N.

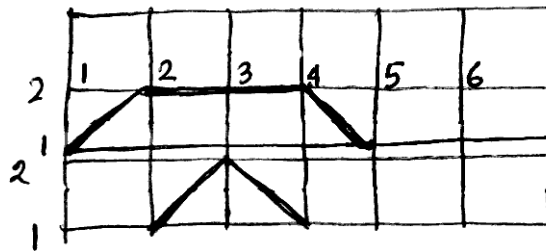




4. a) What is the purpose of a regenerative circuit ? Discuss with suitable hydraulic circuit.
- b) "Hydraulic cylinders sometimes are equipped with cushioning effects." Justify the statement.
- c) Discuss the difference between open loop hydrostatic transmission and closed loop system.
- d) Calculate the tube thickness of a hydraulic cylinder having dimensions as given below :
- Tensile strength of cylinder material =  $7300 \text{ kgf/cm}^2$
- Cylinder bore = 60 mm
- System pressure =  $250 \text{ kgf/cm}^2$
- Factor of safety = 4 : 1 5 + 2 + 4 + 3
5. a) Discuss the applications of accumulators as (i) auxiliary power source, (ii) leakage compensator, (iii) shock absorber.
- b) "An unloading valve is used to save power and energy of a hydraulic circuit." Discuss with a suitable hydraulic circuit diagram.
- c) An accumulator under a pressure of 10 MPa is reduced in volume from  $0.04 \text{ m}^3$  to  $0.03 \text{ m}^3$  while the temperature increases from  $40^\circ\text{C}$  to  $180^\circ\text{C}$ . Determine the final pressure. 6 + 4 + 4
6. a) A pneumatic cylinder is needed to press fit a pin to a hole. Design circuit diagram with a precondition that while actuating both the hands of the operator should be engaged.



- b) What is cascade system of pneumatic circuit design ?  
The sequence diagram of a simple pneumatic system with two double acting cylinders is shown in the figure below. Draw and explain the circuit diagram.

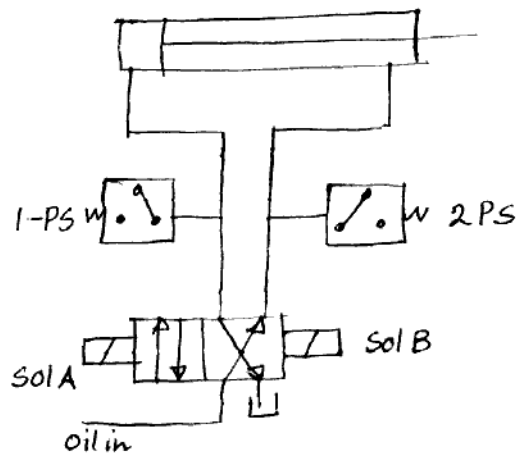


- c) A pneumatic line is designed with (i) 5 Nos. of slide valve, (ii) 15 Nos. of tees, (iii) 10 Nos. of elbows, (iv) 4 Nos. of reducers. If the distance of the compressor to the point of air consumption is 500 m and diameter of pipe is 30 m, find the pressure drop.  $4 + (1 + 4) + 5$
7. a) Draw and explain a pneumatic circuit comprising fluidic sequencing control of two pneumatic cylinders which comprises a preferred flip-flop, an OR/NOR gate, NC limit switches.
- b) 'A lubricator in a pneumatic system works in the principle of venturi.' Justify the statement.
- c) Write short notes on the following :
- Coanda effect
  - AND/NAND gate.

5 + 3 + 6



8. a) What is the difference between 'dead band' and 'hysteresis' ?
- b) Discuss the role of torque motor in actuating electrohydraulic servo valve.
- c) Draw and discuss the electrical ladder diagram and PLC logic ladder diagram of the hydraulic circuit in the figure given below.



3 + 5 + 6

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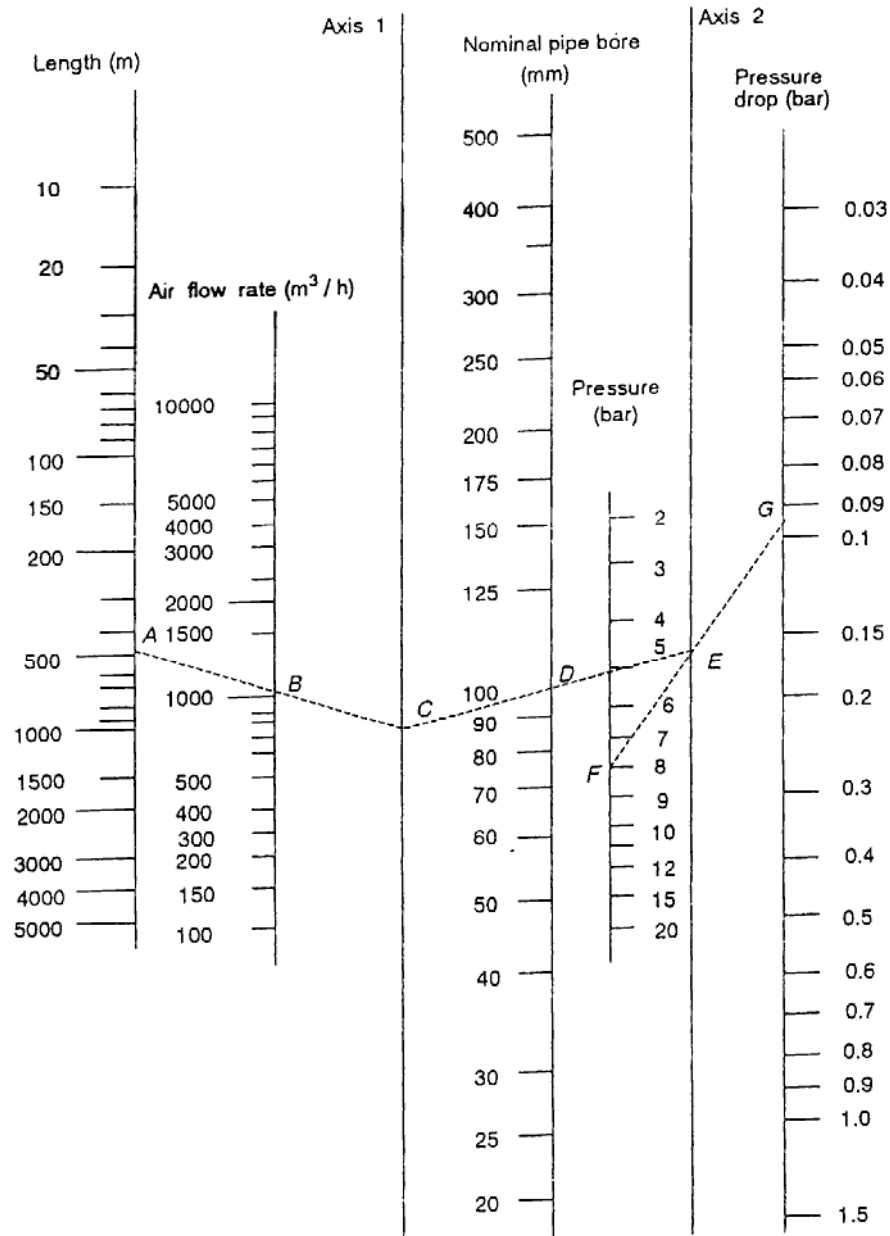


Fig. X: Nomogram for pressure drop

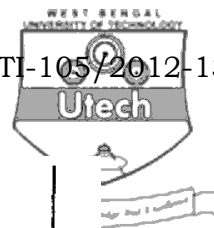


Table Y Equivalent length of pipe fittings

Tube dia in mm	25	50	80	100	125	150	200	250	300	400	500
Fitting											
On-off valve (Two way)	6	15	25	35	50	60	85	110	140	200	260
Corner Radius	3	7	11	15	20	25	35	50	60	85	110
Slide valve	0.3	0.7	1	1.5	2	2.5	3.5	5	6	8.5	11
Elbows	0.2	0.4	0.7	1	1.4	1.7	2.4	3.2	4	6	7
Tees	2	4	7	10	14	17	24	32	40	60	70
Reducers	0.5	1	2	2.5	3.5	4	6	8	10	15	18