Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Course: Pump, compressor, selection sizing and spec. **Semester: I**

Programme: M. Tech. Pipeline Engineering

Time: 03 hrs. **Max. Marks: 100**

Instructions:

SECTION A

S. No.		Marks	CO
Q 1	Classify the various types of air compressors	4	CO1
Q2.	Enlist the benefits of using an inter cooler in multistage air compressors.	4	CO1
Q3.	Define volumetric efficiency of the air compressor, explain how clearance volume affects it.	4	CO1
Q4.	Explain the priming of the centrifugal pump.	4	CO1
Q5.	Explain the advantages of use of air vessels in the reciprocating pumps.	4	CO1
	SECTION B		
Q6.	A single stage double acting air compressor takes air at 0.98 bar and 32^0C and delivered at 6.32 bar. The clearance is 5% of the stroke volume. The compression and expansion follow the law $pv^{1.32}$=C. The air handled by the compressor is 17m^3/min when measured at 1 bar and 15^0C. Determine the temperature of air delivered stroke volume and indicated power of compressor in kW if it runs at 500 rpm. Neglect the area of piston rod and take R= 0.287kJ/kg-K for air.	10	CO2
Q7.	A centrifugal pump impeller runs at 80 rpm and has outlet vane angle for 60^0. The velocity of flow is 2.5 m/s throughout and diameter of the impeller at exit is twice than at inlet. If the manometric head is 20m and the manometric efficiency is75%. Determine; a. The diameter of the impeller at the exit, and b. Inlet vane angle.	10	CO2
Q8.	3 m^3 of water per second is lifted to a height of 30m with an efficiency of 75% by single stage centrifugal pump. The impeller diameter is 300mm and it is rotating at 2000rpm. Find the number of stages and diameter of each impeller of a similar multi stage pump to lift 5 m^3 of water per second to a height of 200m when rotating at 1500 rpm.	10	CO3
Q9.	Explain the working principle of the centrifugal compressor and derive the equation for work done required to drive the compressor. **OR** Explain the working of the reciprocating pump with neat sketch. Derive equation for power required to drive the pump.	10	CO3

SECTION-C			
Q 10.	a. Explain the working of vane type rotary compressor. b. A centrifugal compressor delivers $10m^3/s$ of free air when running at 10000 rpm. The air is drawn in at 1 bar and 300K and delivered at 4 bar. The isentropic efficiency is 80%. Blades are radial at outlet and constant flow velocity is 64 m/s. The outer diameter of impeller is twice the inner and the slip factor may be taken as 0.9. The blade area coefficient at inlet is 0.9 and power input factor is 1.04. Calculate ; I. Temperature of air at outlet II. Power required to drive the compressor III. Impeller diameters at inlet and outlet IV. Width of impeller at inlet V. Impeller blade angle at inlet VI. Diffuser blade angle at inlet.	**5+15**	**CO3**
Q11.	A double acting reciprocating pump is running at 30rpm. Its bore and stroke are 250mm and 400mm respectively. The pump lifts water from a sump 3.8m below and delivers it to tank at a height 65m above the cylinder axis. The lengths of the suction and delivery pipes are 6m and 150m respectively. The diameter of the delivery pipe is 100 mm. if an air vessel of adequate capacity has been fitted on the discharge side, determine; I. The minimum diameter of the suction pipe to prevent cavitation assuming 2.5 m as the minimum head to prevent separation of flow which causes cavitation. II. The maximum gross head against which pump has to work and the corresponding power of motor. Assuming mechanical efficiency 78%, and slip =1.5% Take atmospheric pressure head =10.0 m and friction co-efficient f= 0.012. **OR** A single acting reciprocating pump is to raise a liquid of density 1200 kg/m^3 through a vertical height of 11.5m, from 2.5m below pump axis to 9m above it. The plunger moves with simple harmonic motion, has diameter 125mm and stroke 225mm. the suction and delivery pipes are of 75mm diameter and 3.5 m and 13.5 m long respectively. There is a long vessel placed on the delivery pipe near the pump axis but there is no air vessel on the suction pipe. If separation takes place 0.88bar below atmospheric pressure find; I. Maximum speed with which the pump can run without separation taking place, and II. Power required to drive the pump if coefficient of friction in pipe = 0.02 Neglect slip for the pump.	**20**	**CO4**