Name: **Enrolment No:**	UPES

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

Course: Pumps, Compressors, and fans (MPEG704) **Semester: I**
Programme: M. Tech. Rotating Equipment
Time: 03 hrs. **Max. Marks: 100**
Instructions: Assume suitable data, if required.

SECTION A

S. No.		Marks	CO
Q 1	Explain priming of the centrifugal pump.	4	CO1
Q2.	Draw an illustrative diagram of a centrifugal compressor stage indicating the names of its principal parts.	4	CO1
Q3.	Define the degree of reaction, rotor and stage pressure coefficients and stage efficiency for fans.	4	CO1
Q4.	Explain three methods which may be adopted to control the amount of air delivered by a compressor, and point out the main advantages of each.	4	CO2
Q5.	Explain the advantages of air vessels fitted in the reciprocating pump.	4	CO1
	SECTION B		
Q 6.	A single acting reciprocating pump has its piston executing a simple harmonic motion. Show that the ratio of work done against friction when the air vessels are fitted to that in the absence of air vessel is $3/2\pi^2$ **OR** a. Explain the cavitation of centrifugal pump. Derive equation for the thoma's cavitation factor. b. Define the net positive suction head.	10 or (7+3)	CO2
Q7.	A single stage double acting air compressor delivers air at 7 bar. The pressure and temperature at the end of suction stroke are 1 bar and 27^0C. It delivers 2 m^3 of free air per minute when the compressor is running at 300 rpm. The clearance volume is 5% of the stroke volume. The pressure and temperature of ambient air are 1.03 bar and 20^0C. Index of compression =1.3, index of re-expansion=1.35. find a). the volumetric efficiency of the compressor. b). indicated power of the compressor and brake power, if the mechanical efficiency is 80% c). the diameter and stroke of the cylinder if both are equal.	10	CO2

Q8.	Air at a temperature of 290 K flows in a centrifugal compressor running at 20000rpm. The other data given is as follows Slip factor= 0.80; isentropic total head efficiency = 0.75; outer diameter of blade tip = 500mm. Assuming the absolute velocities of air at inlet and exit of the compressor are same. Calculate ; a). the temperature rise of air passing through the compressor, and b). the static pressure ratio. Take Cp= 1.00035 kJ/kg-K.	**10**	**CO3**
Q9.	A single acting two stage compressor with complete inter cooling delivers 5 kg per min of air at 15 bar pressure. Assuming an intake state of 1 bar and 15^0C and that the compression and expansion processes are polytropic with index of(n)= 1.3, Calculate the power required and the isothermal efficiency, if the speed is 420rpm. Assuming the clearance volume of LP and HP cylinder to be 5%and 6% of the respective cylinder swept volumes, calculate swept and clearance volume for cylinders.	**10**	**CO3**
	SECTION-C		
Q 10	A double acting single cylinder reciprocating pump of 12.5 cm bore and 25cm stroke runs at 36 rpm. The centre of pump is 4 m above the level of water in the sump and 30 m below the delivery water level. The length of the suction and delivery pipes are 6 m and 35m and the diameter of each pipe is 6 cm. Assuming simple harmonic motion, find the pressure head in metres of water on the piston at the beginning, mid, and end of the suction and delivery strokes. Take atmospheric pressure head 10.3m of water and friction coefficient f= 0.01 for both the pipes. If the mechanical efficiency is 75%, calculate the power required to drive the pump. Also calculate the maximum head at any instant against which the pump has to work and its corresponding duty. OR Water enters radially through a centrifugal pump whose impeller has a diameter of 30cm and breadth 15cm; the corresponding dimensions at the outer periphery are 60 cm and 7.5cm. the blades are curved backward at 30^0 to the tangent at exit and the discharge is 225 lites per second. If the rotational speed of the impeller is 1200 rpm and the pump delivers water to a height of 115 m, calculate a). the theoretical head developed and the manometric efficiency , b). the pressure rise across the impeller assuming losses equal to 10 % of velocity head at exit, c). the pressure rise and the loss of head in the volute casing, d). the vane angle at inlet.	**20**	**CO4**
Q11	A centrifugal fan has the following data: Inner diameter of the impeller is 18 cm Outer diameter of the impeller 20cm Speed 1450rpm The relative and absolute velocities respectively are	**20**	**CO5**

	At entry 20m/s, 21 m/s At exit 17m/s. 25 m/s Flow rate 0.5kg/s Motor efficiency 78% Determine ; a). the stage pressure rise b). degree of reaction, and c). the power required to drive the fan take density of the air as 1.25 kg/m^3		