Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Pumps, compressors, and fans **Semester: I**
Program: M. Tech. Rotating Equipment Engineering **Time 03 hrs.**
Course Code: MERE7001 **Max. Marks: 100**

Instructions:

SECTION A

S. No.		Marks	CO
Q1.	Discuss the surging and chocking of compressors.	**4**	**CO1**
Q2.	Enlist the advantages of the air vessels in reciprocating pumps.	**4**	**CO1**
Q3.	Compare rotary and reciprocating compressor	**4**	**CO1**
Q4.	Differentiate between fans, blower and compressors.	**4**	**CO1**
Q5.	Describe the net positive suction head of centrifugal pump.	**4**	**CO1**
	SECTION B		
Q6.	A single acting reciprocating pump has a diameter of 50 cm and stroke 50 cm. It takes its supply of water from sump 3.5 below the pump axis through a pipe 10m long and 20 cm diameter. If separation occurs at 2.5 meters of water absolute; make calculation for: (a) speed at which separation may take place at the commencement of suction stroke (b) change in speed of pump if an air vessel is fitted on the suction side 2.5m above the sump water level. Take coefficient of friction = 0.01 and barometric head = 10.3 m of water.	**10**	**CO2**
Q7.	A multistage centrifugal pump is to be installed to lift water through a head of 80m at the rate of $0.1 m^3/s$. the pump is coupled to an electric motor running at 1000 rpm. Find; (a) The head developed per stage and the required number of stages, (b) The required impeller diameter if the speed ratio based on the impeller diameter is 0.9, and (c) The power required. Assume the overall efficiency is 75% and the specific speed of each impeller is 30.	**10**	**CO2**
Q8.	A single stage, double acting air compressor delivers 15 m^3 of air per minute measured at 1.013 bar and temperature 27^0C and delivers at 7 bar. The conditions at the end of the suction stroke are 0.98 bar and temperature 40^0C. The clearance volume is 4% of the swept volume and the stroke/bore ratio is 1.3/1, compressor runs at 300 rpm. Calculate the volumetric efficiency, cylinder dimensions, indicated power and isothermal efficiency of the compressor. Take the index of compression and expansion as 1.3, R= 0.287kJ/kgK.	**10**	**CO4**

Q9.	A single cylinder, single acting air compressor delivers 10kg of air /min. from 1 bar and 27^0C to 6 bar. The compression follows the law $pv^{1.25}$= C. determine; (a) Work required to compress and deliver 1 kg of air (b) Actual power required to run the compressor if the mechanical efficiency is 80% (c) Head lost through the cylinder wall per minute (d) Isothermal efficiency Take c_p= 1.005kJ/kg-K, c_v= 0.718kJ/kgK **OR** A two stage centrifugal compressor delivers 140m^3 of air per minute. The suction condition of air is 1 bar and 17^0C. The air is passed to intercooler after first stage of compression and cooled to 22^0C. If the pressure ratio of each stage is 2 and isentropic efficiency is 70%, find the I.P. required to drive the compressor.	**10**	**CO3**
SECTION-C			
Q10.	A centrifugal fan running at 1500rpm has inner and outer diameter of the impeller as 0.2 m and 0.24m. The absolute and relative velocities of air at entry are 21m/s and 20m/s respectively and those at exit are 25m/s and 18 m/s respectively. The flow rate is 0.6 kg/s and the motor efficiency is 80%. Determine (a) the stage pressure rise (b) degree of reaction and (c) the power required to drive the fan. Assuming the flow to be incompressible with the density of air as 1.2kg/m^3.	**20**	**CO4**
Q11.	A centrifugal compressor is desired to have a total pressure ratio 3.5:1. The inlet eye of the compressor impeller is 30 cm in diameter. The axial velocity at inlet is 130m/s. and the mass flow is 10kg/sec. the velocity in the delivery duct is 115m/sec. the tip speed of the impeller is 450m/sec. and runs at 16000rpm with total head isentropic efficiency of 78% and pressure coefficient of 0.72. The ambient conditions are 1.013 bar and 15^0C calculate: (a) the static pressure ratio, (b) the static pressure and temperature at inlet and outlet of compressor, (c) work of compressor per kg of air, and (d) the theoretical power required. OR The following particulars refer to two- stage single acting air compressor: Capacity 4.5m^3 per minute measured under free conditions at 15^0C and 1.013 bar. Delivery pressure = 17.2 bar; suction pressure = 0.98bar. Temperature at the start of compression =30^0C Clearance volume of L.P. cylinder = 6% Index of compression = 1.2, speed = 120rpm Assuming that the intercooler pressure is chosen such that the work is shared equally between the two cylinders, calculate: (a). the indicated power (b) the dimensions of L.P. cylinder if the bore = stroke.	**20**	**CO3**