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

Course: Pumps, compressor, selection , sizing and spees   Semester: I
Program: M. Tech Pipeline Engineering   Time 03 hrs.
Course Code: MECH7001   Max. Marks: 100

Instructions:

SECTION A

S. No.		Marks	CO
Q 1	What is the significance of characteristic curve of centrifugal pumps?	4	CO1
Q2	Describe clearly the term slip and power input factor as applied to centrifugal compressor.	4	CO1
Q3	Explain construction detail of globe valve.	4	CO1
Q4	What is the importance of the (Net positive suction head) NPSH.	4	CO1
Q5	Discuss the advantages of the use of intercooler in the compressor.	4	CO1

SECTION B

Q6	A centrifugal pump impeller whose runs at 80 RPM and has outlet vane angle of 60^0. The velocity of flow is 2.5 m/s throughout and diameter of the impeller at exit is twice that at inlet. If the manometric head is 20m and the manometric efficiency is 75%, Determine: The diameter of the impeller at the exit and Inlet vane angle.	10	CO2
Q7	A single acting reciprocating pump, running at 50 rpm. Delivers $0.008 m^3$/s of water. The diameter of the piston is 250mm and stroke length 350mm. the suction and delivery heads are 3.8 and 11.4m respectively. Determine: a) Theoretical discharge, b) Coefficient of discharge, c) Percentage slip of the pump, d) Power required to run the pump.	10	CO2
Q8	A centrifugal compressor delivers 50 kg of air per minute at a pressure of 2 bar and 97^0C. The intake pressure and temperature of the air is 1 bar and 15^0C. If no heat loss to the surrounding, find: a) index of compression and b) power required, if the compression is isothermal. Take R= 287 j/kgK.	10	CO3

Q9	Find the diameter and stroke of a single- stage, single acting air compressor. The pressure at inlet and discharge are 1.1 bar and 7.7 bar respectively. The speed of the compressor is 240 r. p. m. and speed of the piston is limited to 150m/min. the I.P. of the compressor is 14 kW. Neglect the effect of clearance and assume the index for compression and re expansion is 1.2. OR A centrifugal pump running at 1000rpm discharges 250litres/min of water against a lift of 30 m. at the outlet, the vanes are swept back at 30 degrees and the velocity of flow is 3m/s. if the hydraulic efficiency is 80 percent, determine the diameter and width of impeller at outlet.	10	CO3

	SECTION-C		
Q 10	A centrifugal compressor runs at 250 rev/s and delivers 10 kg of air/s at a pressure ratio of 4.5:1. The slip factor and the isentropic efficiency are 0.9 and 0.8 respectively. The flow velocity of air in the impeller at inlet and at exit is equal to 150m/s. the flow coefficient at the impeller exit= 0.3. The hub diameter of the eye = 15 cm. Assuming equal pressure ratio in impeller and diffuser and ambient conditions as 20^0C and 100kN/m^2 calculate: a) The impeller diameter at the impeller exit, and inlet. b) The power required to drive the compressor. c) Width of the impeller at its exit. <center>**OR**</center> A centrifugal compressor delivers 9m^3/s of free air when running at 11000 rpm. The air is drawn in at 1 bar and 300K and delivered at 3.5 bars. The isentropic efficiency is 85%. Blades are radial at the outlet and constant flow velocity is 65m/s. The outlet 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: temperature of air at outlet, power required to drive the compressor, impeller diameter at inlet and outlet, width of the impeller at inlet, the impeller blade angle at inlet and diffuser blade angle at inlet.	20	CO4
Q11	a. A single acting, single stage air compressor is required to compress 2.8 kg of air per minute at 1.013 bar and temperature 27^0C to a pressure of 7.1 bar. The clearance volume is 5% of the stroke volume and the law for compression and for expansion is pv$^{1.25}$= constant. If the stroke is 1.2 times the bore and compressor runs at 150 rpm. Determine the size of cylinder R= 0.287kJ/kg-K. What is the net heat transferred per minute during compression and expansion stroke? Take γ= 1.4 b. Explain the different efficiencies involve with the centrifugal pump.	15+5	CO4, CO1