Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fourth semester B.Tech examinations (S), September 2020

Course Code: ME206

Course Name: FLUID MACHINERY (ME)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three questions, each carries 10 marks Marks

1	a)	A nozzle forming a jet of 50 mm diameter is supplied with water under a constant head of 75 m. The jet is directed to strike perpendicularly on to a fixed flat plate. Calculate the force exerted by the jet on the plate. Take velocity coefficient of the nozzle as 0.92.	4
	b)	Show that the maximum efficiency for a semi-circular vane when the jet strikes at the centre is 59.26 %.	6
2	a)	Differentiate between inward flow and outward flow reaction turbines.	3
	b)	Water flows through a vertical Francis turbine at the rate of 15.5 m^3/s and makes its runner to rotate at 428.4 rpm. The velocity and pressure head at the inlet of the spiral casing are 8.5 m/s and 240 m respectively and the centre line of its inlet is 3 m above the tail race level. The diameter and width of the runner at inlet are 2 m and 300 mm respectively, determine output power, guide vane angle and runner vane angle at inlet.	7
3	a)	Give the significance of unit and specific quantities.	3
	b)	Define unit speed, unit discharge and unit power of a turbine.	3
	c)	In a projected low head hydroelectric scheme 283 m^3/s of water are available under a head of 3.66 m. Alternative schemes to use Francis turbines having a specific speed of 400 or Kaplan turbines with a specific speed of 686 are investigated. The normal running speed is 50 rpm in both the schemes. Compare the proposals so far as the numbers of machines are concerned and estimate the power to be developed by each machine. The units in either installations are to be of equal power and the efficiency of each type may be assumed to be 90%.	4
4	a)	Illustrate the functions of surge tanks.	4
	b)	Illustrate cavitations in hydraulic turbines.	6

PART B

Answer any three questions, each carries 10 marks

5	a)	State the differences between a radial flow turbine and a rotodynamic pump.	3
	b)	Write short note on 'multi stage centrifugal pumps'.	7
6	a)	What do you mean by NPSH?	3
	b)	Derive an expression for the minimum starting speed of a centrifugal pump.	4
	c)	Find the number of pumps required to take water from a deep well under a total head of 89 m. All pumps are identical and running at 800 rpm. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m^3/s.	3
7	a)	Distinguish between rotodynamic pump and positive displacement pump.	4
	b)	The diameter and stroke of a single acting reciprocating pump are 200 mm and 400 mm respectively. The pump runs at 60 rpm and lifts 12 litres of water per second through a height of 25 m. The delivery pipe is 20 m long and 150 mm in diameter. Find the theoretical power required to run the pump, percentage of slip and acceleration head at the beginning and middle of the delivery stroke.	6
8	a)	With a neat diagram illustrate the working of 'hydraulic accumulator'.	6
	b)	Illustrate the working of 'jet pump'.	4

PART C

Answer any four questions, each carries 10 marks

9		A single acting reciprocating air compressor delivers air at 7.5 bar. The pressure and temperature at the end of suction stroke are 1 bar and 25^0C. It delivers 2.2 m^3 of free air when running at 310 rpm. The clearance volume is 5% of stroke volume. The pressure and temperature of ambient air are 1.03 bar and 20^0C. If the compression follows $PV^{1.25} = C$ and expansion follows $PV^{1.3} = C$ determine the volumetric efficiency of the compressor, diameter and stoke of the cylinder if both are equal, indicated power and brake power if the mechanical efficiency is 85%.	10
10	a)	With the help of neat diagrams illustrate the working of a multi stage reciprocating air compressor. List the advantages of multi stage compression over single stage compression.	6
	b)	Define and derive volumetric efficiency of a reciprocating compressor in terms of clearance ratio.	4
11	a)	Derive the relation between suction pressure, intermediate pressure and delivery	7

pressure for a two stage reciprocating air compressor with perfect intercooling.

b) Compare reciprocating and rotary air compressors. 3

12 A single inlet type centrifugal compressor handles 528 kg/min. of air. The ambient air conditions are 1 bar and 20^0C. The compressor runs at 20000 rpm with isentropic efficiency of 80%. The air is compressed in the compressor from 1 bar static pressure to 4 bar total pressure. The air enters the impeller eye with a velocity of 145 m/s with no pre-whirl. Assuming that the ratio of whirl speed to tip speed is 0.9, calculate rise in total temperature during compression if the change in kinetic energy is negligible, the tip diameter of the impeller, power required and eye diameter if the hub diameter 12 cm. 10

13 a) Explain the construction and working of an axial flow air compressor. 7

b) Define degree of reaction. Discuss the significance of 50% reaction blading. 3

14 a) Explain surging and choking in centrifugal compressors. 5

b) Explain the construction and working of roots blower. 5

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