CBCS SCHEME - Make-Up Exam

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BME502

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define turbomachine. Differentiate positive displacement machine and turbomachines with respect to various parameters.	8	L1	CO1
	b.	Obtain an expression for specific speed of a turbine.	6	L2	CO1
	c.	A $\frac{1}{5}^{th}$ scate model turbine working under a head of 15 m the prototype turbine is required to work under a head of 30 m and running at 450 rpm. Determine the speed of model if it develops 98 KW at his speed. If the specific speed is same, determine the power developed by the prototype turbine and name the type of turbine.	6	L3	CO1
		OR			
Q.2	a.	Obtain the expressions for a turbomachine by applying the first law and second law of thermodynamics.	10	L2	CO1
	b.	A two-stage steam turbine develop 22 MW at the shaft. The inlet temperature is 1500 K. The overall pressure ratio of the turbine is 8 and the isentropic expansion efficiency is 0.9. Assume pressure ratio of each stage is same. Calculate : i) Pressure ratio of each stage ii) Polytrophic efficiency iii) Mass flow rate. Assume overall drive efficiency = 0.9.	10	L3	CO1
		Module – 2			
Q.3	a.	Define Degree of Reaction and utilization factor obtain an expression for relation between two.	10	L2	CO2
	b.	In a radial inward flow turbine, the runner outer diameter is 75 cm and the inner diameter is 50 cm. The runner speed is 400 rpm. Water enters the runner at a velocity of 15 m/s at an angle of 15°. The velocity of fluid at the exit is 5 m/s and discharges radiantly. Find : i) Blade angles at inlet and exit ii) Degree of reaction iii) Utilization factor iv) Power output for unit mass flow rate.	10	L3	CO2
		OR			
Q.4	a.	A radial outward flow turbomachine has no inlet whirl The blade speed at the exit is twice that the inlet. Radial velocity is constant throughout. Inlet blade angle is 45° . Show that the degree for action. $R = \frac{2 + \cot\beta_2}{4}$	10	L3	CO2
	b.	Obtain an expression for theoretical head-capacity relationship and effect on blade discharge angles in the performance of centrifugal pump or compressor.	10	L2	CO2

Q.5	a.	What is compounding in turbomachines? Mention the different types of compounding methods. Explain any one method of compounding in turbines.	10	L1	CO3
	b.	Steam issues from a De Laval Turbine at a velocity of 1000 m/s. The nozzle angle is 20°. The mean blade velocity is 400 m/s. The blades are symmetrical. The mass flow rate is 1000 kg/h, blade friction coefficient is 0.8. Determine : i) Blade angles ii) Axial thrust iii) Power developed iv) Blade efficiency.	10	L3	CO3
		OR			
Q.6	a.	Obtain an expression for maximum blade efficiency of single stage impulse turbine.	10	L2	CO3
	b.	In a parson turbine running at 1500 rpm, the available enthalpy drop (total) is 63 kJ/kg. If the mean diameter of the rotor is 100 cm, Find the number of moving rows required stage efficiency = 0.8, blade outlet angle = 20°, speed ratio = 0.7.	10	L3	CO3
		Module – 4			
Q.7	a.	With a neat sketch, explain the working principle of Pelton wheel with parts and represent the velocity diagrams.	10	L1	CO4
	b.	A Pelton wheel develops 5800 KW under a net head of 180 m at a speed of 195 rpm. Find the discharge through the turbine, the wheel diameter, the number of jets required and the specific speed. Take $\eta_{overall}$ = 86%, D/d = 12, ϕ = 0.45 and C_v = 0.985.	10	L3	CO4
		OR			
Q.8	a.	With a neat sketch, explain the working of Kaplan turbine. Draw its velocity triangles. Also explain the functions of draft tube.	10	L2	CO4
	b.	For a Francis turbine, the Net Head = 70 m speed = 600 rpm, Shaft power = 370 KW, Overall efficiency is 85%, Hydraulic efficiency is 95%, flow ratio = 0.25, Breadth ratio = 0.1, outer diameter of the runner is 2 times inner diameter of runner, the thickness of vanes occupies 10% of the circumferential area of the runner, velocity of flow is constant and discharge is radial at outlet. Determine : i) The guide blade angle ii) The runner vane angles iii) Diameter of runner at inlet and outlet iv) Width of wheel at inlet.	10	L3	CO4
		Module – 5			
Q.9	a.	With a neat sketch, explain the working principle of centrifugal pump and represent its velocity triangles.	7	L1	CO5
	b.	Explain pumps in series and pumps in parallel.	6	L2	CO5
	c.	A centrifugal pump delivers 50 liters of water/sec against a head of 24 m running at 1500 rpm. The velocity of flow is 2.4 m/s and is constant, and the blades are set back at 30°. The inner diameter is half the outer diameter. If the manometric efficiency is 80%, determine the blade angles and power required to drive the pump	7	L3	CO5

		OR			
Q.10	**a.**	Explain the experimental study of centrifugal flower representing tabulations, observations and formulae used.	**10**	**L4**	**CO5**
	b.	An axial compressor stage has the following data inlet conditions are 1 bar and 25°C, degree of reaction is 0.5, mean blade ring diameter is 360 mm, rotational speed is 18,000 rpm, blade height at entry is 180 mm, air angles at rotor and stator exit are 25° (with respect to axial direction) axial velocity is 180 m/s, work done factor is 0.88, stage efficiency is 85% and mechanical efficiency is 96.7% Determine the : i) Air angles at rotor and stator entry ii) Mass flow rate of air iii)Power required to drive compressor.	**10**	**L3**	**CO5**

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