U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2024 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCTUM **Max Marks: 100**
Course: Turbo Machines

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Define Turbomachines. Give at least 4 different classifications of turbomachines.	*CO1*	*PO1*	**06**
	b)		Define the following. i) Flow coefficient ii) Specific speed	*CO1*	*PO1*	**04**
	c)		Derive alternate form of Euler's turbine equation and explain the significance of each energy component.	*CO1*	*PO1*	**10**
			UNIT - II			
2	a)		Derive the pressure ratio in terms of work done factor for a centrifugal compressor.	*CO3*	*PO1*	**06**
	b)		Define following i) Power input factor ii) Pressure coefficient	*CO1*	*PO1*	**04**
	c)		A centrifugal compressor running at 5950 RPM having an impeller tip diameter=100cm. Mass flow rate of air is 30 kg/s, total pressure ratio=2.125, pressure at inlet is 1bar and temperature is 25°C, slip coefficient, μ=0.9 and η_{mech}=0.97. Find i) Total efficiency ii) Temperature of air at exit iii) Power input needed and iv) Pressure coefficient.	*CO3*	*PO2*	**10**
			OR			
3	a)		With reference to the axial flow compressor explain i) Radial equilibrium ii) Work done factor	*CO3*	*PO1*	**10**
	b)		An axial compressor of 50% reaction design has blades with inlet and outlet angles with respect to axial direction of 45° and 10° respectively. The compressor is to produce a pressure ratio of 6:1 with an overall isentropic efficiency of 0.85 when inlet static temperature is 37°C. The blade speed and axial velocity are constant throughout the compressor. Assuming a value of 200 m/s for blade speed, find the number of stages required, if the work done factor is i) Unity ii)0.87 for all stages.	*CO3*	*PO2*	**10**

			UNIT – III			
	4	a)	Obtain an expression for minimum starting speed of a centrifugal pump.	***CO3***	***PO1***	**10**
		b)	The centrifugal pump having an outer diameter equal to two times the inner diameter and running at 1000 rpm, working under a head of 30m. Velocity of flow through the impeller is constant and is equal to 2.5 m/s. Vanes are set back at an angle of 40° at the outlet. If the outer diameter is 50cm, width of the outlet is 5cm. Calculate i) Vane angle at the inlet. ii) Work done by the impeller. iii) Mechanical Efficiency.	***CO3***	***PO2***	**10**
			UNIT - IV			
	5	a)	Show that the maximum efficiency for an impulse turbine is given by $\cos^2\alpha_1$, where α_1 is the angle at which steam enters the blades, with the help of the combined velocity triangle.	***CO2***	***PO1***	**10**
		b)	Steam issues from the nozzle of a Delaval turbine with a velocity of 1200 m/s. The nozzle angle is 20° and the mean blade velocity is 400m/s. Inlet and outlet angles are equal. Mass of steam flowing through the turbine is 900 kg/hr. calculate i)Blade angles ii)Relative velocity of steam entering the blades iii)Tangential force on the blade iv)Power developed v)Blade efficiency. Assume C_b =0.8	***CO3***	***PO2***	**10**
			UNIT - V			
	6	a)	Obtain an expression for the work done/sec by water on the runner of the Pelton wheel, and derive an expression for maximum efficiency of Pelton wheel giving the relationship between the jet speed and bucket speed.	***CO2***	***PO1***	**10**
		b)	A three jet Pelton turbine is required to generate 10,000 kW under a net head of 400m. The blade angle at outlet is 15° and reduction in the relative velocity while passing over the blades is 5%. If the overall efficiency of the wheel is 80%. C_v=0.98 and the speed ratio is 0.46, then find i)Total flow in m^3 ii)Discharge through each jet iii)Diameter of the jet iv)Force exerted by jet on the wheel.	***CO3***	***PO2***	**10**
			OR			
	7	a)	Briefly explain with neat sketches different types of draft tubes in reaction hydraulic turbines.	***CO1***	***PO1***	**10**
		b)	Design an inward flow Francis turbine whose power output is 330 kW under a head of 70m running at 750 rpm, Hydraulic Efficiency =94%, Overall Efficiency =85%. The flow ratio at inlet is 0.15. The breadth ratio is 0.1. The outer diameter of the runner is twice the inner diameter of the runner. The thickness of the vanes occupy 6% of the circular area of the runner. Flow velocity is constant and discharge is radial at outlet.	***CO4***	***PO2***	**10**

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