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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. | **Semester: V/VI**
Branch: Mechanical Engineering | **Duration: 3 hrs.**
Course Code: 20ME5DCTUM / 16ME6DCTUM | **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)	Derive the generalized Euler's turbine equation of motion for turbomachines and write the assumptions.	*CO1*	*PO1*	**10**
	b)	Define, i) flow coefficient and ii) specific speed.	*CO1*	*PO1*	**04**
	c)	Explain how turbomachines are classified.	*CO1*	*PO1*	**06**
		OR			
2	a)	Derive the alternate form of Euler equation with appropriate velocity triangles and explain the significance of each term.	*CO1*	*PO1*	**10**
	b)	The Francis turbine model is built to scale of 1:5 with the following data. Model data — Prototype data P=4 kW — P=? N=350 rpm — N=? H=2 m — H=6 m Assume the overall efficiency of the model is 70%. Calculate the speed of the prototype and the power.	*CO1*	*PO1*	**07**
	c)	Define turbomachines and list out the different parts for the same.	*CO1*	*PO1*	**03**
		UNIT - II			
3	a)	Derive the pressure ratio equation for single stage centrifugal compressor starting from steady flow energy equation.	*CO1*	*PO1*	**08**
	b)	What is surging in centrifugal compressor?	*CO1*	*PO1*	**04**
	c)	A two-stage centrifugal compressor delivers 500 m^3 of free air per min. The suction conditions are 1 bar and 15^o C. The	*CO1*	*PO1*	**08**

			compression ratio and isentropic efficiency of each stage is 1.25 and 80% respectively. Find the isentropic efficiency for the entire compression process. Also illustrate the process on T-s plot.			
			OR			
	4	a)	Define the terms, i) flow coefficient, ii) pressure coefficient, and iii) degree of reaction.	*CO1*	*PO1*	**06**
		b)	For axial flow compressor derive radial equilibrium condition.	*CO1*	*PO1*	**08**
		c)	An axial flow compressor stage has the following data: Stagnation temperature and pressure are 20^oC and 1 bar, with 50% degree of reaction; flow coefficient = 0.50; mean blade ring diameter = 35 cm; speed 18000 rpm; air angles at rotor and stator exit are 60^0; blade height at entry 5 cm; work done factor = 0.88; isentropic and mechanical efficiency as 85% & 96%. Determine air angles at rotor and stator entry, mass flow rate of the air, and power to drive the compressor.	*CO1*	*PO1*	**06**
			UNIT - III			
	5	a)	Define the following terms related to centrifugal pump. i) Manometric efficiency; ii) Mechanical Efficiency; iii) Hydraulic efficiency; iv) volumetric efficiency; and v) overall efficiency.	*CO2*	*PO2*	**05**
		b)	Derive the correlation for minimum starting speed for pump.	*CO2*	*PO2*	**05**
		c)	A centrifugal pump runs at 950 rpm with its inner and outer diameters are 250 mm and 500 mm respectively. The vanes are set back at 35^o to the wheel rim. If the radial velocity of the water through impeller is constant at 4 m/s, find: i) vane angle at the inlet, ii) velocity of water at outlet, iii) direction of water at outlet, and iv) work done by the impeller per kg of water. Assume the entry of water is radial.	*CO2*	*PO2*	**10**
			OR			
	6	a)	Explain cavitation phenomenon in pump. Discuss the series and parallel multistage pump arrangement with suitable schematic sketch.	*CO2*	*PO2*	**06**
		b)	Derive the pressure rise equation considering impeller and manometric head with the help of Bernoulli's equation.	*CO2*	*PO2*	**06**
		c)	A centrifugal pump delivers 1800 liters/min against height of 20 mts with 1450 rpm. Inner and outer diameter of impeller are 120 mm and 240 mm respectively and diameter of suction and delivery pipes are 100 mm. Determine the blade angles at the inlet and outlet by neglecting friction and other losses.	*CO2*	*PO2*	**08**

			UNIT - IV			
	7	a)	Explain, 'Velocity compounding' in steam turbine.	*CO2*	*PO2*	**06**
		b)	Differentiate between impulse and reaction steam turbines.	*CO2*	*PO2*	**06**
		c)	Steam discharged from a nozzle in De laval turbine at a velocity of 1000 m/s, with nozzle angle of 20^0 at a mean blade velocity of 400 m/s. The blades are symmetrical. The mass flow rate of steam is 1000 kg/hour, friction factor is 0.80, nozzle efficiency is 95%. Calculates, i) blade angle, ii) axial thrust, iii) work done per kg, iv) power develop, and v) blade efficiency.	*CO2*	*PO2*	**08**
			OR			
	8	a)	Explain, 'Pressure compounding' in steam turbines.	*CO2*	*PO2*	**06**
		b)	Enlist any 6 advantages of steam turbines over other prime movers.	*CO2*	*PO2*	**06**
		c)	Steam at 300 m/s is supplied to single stage impulse turbine through nozzle. The nozzle angle is 25^0, the mean diameter of the blade rotor is 100 cm and it has a speed of 2000 rpm. Find suitable blade angle if there is no axial thrust. If the blade velocity coefficient is 0.90 and steam flow rate is 10 kg/sec, find the power developed.	*CO2*	*PO2*	**08**
			UNIT - V			
	9	a)	With help of velocity triangle, derive expression for hydraulic efficiency of a Pelton turbine.	*CO2*	*PO2*	**10**
		b)	A dam power house is proposed to be built for Francis turbine with design head of 16 mand flow rate of 8 m^3/s. The speed is to be 250 rpm with an overall efficiency of 90% and hydraulic efficiency of 95%, speed ratio of 0.76 and flow ratio of 0.35. Obtain wheel diameters, vane width, inlet guide angle, vane angle and power developed. Consider the inner diameter is half of the outer diameter, discharge does not have any whirl component and neglect vane thickness.	*CO2*	*PO2*	**10**
			OR			
	10	a)	A Kaplan turbine runner is to be designed to develop 9000 kW. The net available head is 6 m. If the speed ratio is 2.01 and the flow ratio is 0.70, overall efficiency is 87%, the diameter of the boss being $1/3^{rd}$ of the diameter of runner, find the diameter of the runner, its speed and specific speed of the turbine.	*CO2*	*PO2*	**10**
		b)	Explain necessity of draft tube and with neat sketches discuss different types of draft tubes.	*CO2*	*PO2*	**10**

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