U.S.N.										

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

Autonomous Institute Affiliated to VTU

June / July 2024 Semester End Main Examinations

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

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)	Quantity of water available for a hydel station is 310 m^3/s under a head of 1.8 m. Assuming speed of each turbine as 85%. Find the number of turbines required and power developed by each turbine. Each turbine has a specific speed of 800 metric.	*CO1*	*PO2*	**06**
	b)	Define: i) Head coefficient ii) Flow Coefficient	*CO1*	*PO1*	**04**
	c)	Derive an expression for Euler turbine equation and obtain its alternative form.	*CO2*	*PO1*	**10**
		UNIT-II			
2	a)	Derive an expression for over all pressure ratio of a Centrifugal compressor.	*CO2*	*PO1*	**06**
	b)	Explain surging in centrifugal compressor with the help of a neat graph.	*CO2*	*PO1*	**04**
	c)	Initial conditions of the air entering a centrifugal compressor are l bar and 10°C static. The power input to the compressor is 450 kW. The total pressure at exit is 5 bar. The velocity of air at inlet is 150 m/s and the speed of the compressor is 20,000 rpm. The hub diameter is 12 cm. Assume the isentropic efficiency as 0.8 and slip factor as 0.9. Calculate (i) the change in total temperature, (ii) the impeller diameter at outlet and inlet and (iii) the mass flow rate of air.	*CO2*	*PO2*	**10**
		OR			
3	a)	Derive an expression for radial equilibrium theory in axial flow compressors. Clearly state the assumptions made.	*CO2*	*PO1*	**10**

		b)	The speed of an axial flow compressor is 15,000 rpm. The mean diameter is 0.6 m. The axial velocity is constant and is 225 m/s. The velocity of whirl at inlet is 85 *m/s*. The work done is 45 kJ/kg of air. The inlet conditions are 1 bar and 300 K. Assume a stage efficiency of 0.89. Calculate (i) the fluid deflection angle, (ii) the pressure ratio, (iii) the degree of reaction, (iv) the mass flow rate of air, and (v) the shaft power, if mechanical efficiency is 0.95. The power developed is 425 kW.	*CO2*	*PO2*	**10**
			UNIT - III			
	4	a)	With the help of neat schematic diagram of the centrifugal pump. Explain the different pressure heads associated with it. Discuss Manometric head and Manometric efficiency.	*CO2*	*PO1*	**08**
		b)	Derive an expression for minimum starting speed of a Centrifugal pump	*CO2*	*PO1*	**04**
		c)	A Centrifugal pump delivers 50 liters of water per second. The total head is 24 m at speed of 1500 rpm. The velocity of flow is maintained constant at 2.4 m/s and the blades are curved backwards at 30 degree to tangent at exit. The inlet diameter is half the outlet diameter and manometric efficiency is 80%. Find the blade angle at the inlet, power required to drive the pump and torque required.	*CO2*	*PO2*	**08**
			UNIT-IV			
	5	a)	Inlet velocity of a steam in a steam turbine is 150 m/s, ratio of flow velocity to linear blade speed at inlet and outlet are 0.75 and 0.78 respectively. Discharge blade angles of stator and rotor are 20°. Mass flow rate of steam is 2.5 kg/s. Construct the inlet and outlet velocity triangles by graphical method. Determine the Work done, Power developed and Degree of reaction for the turbine.	*CO3*	*PO2*	**10**
		b)	Explain Pressure compounding and Velocity compounding with the help of neat sketches.	*CO3*	*PO1*	**10**
			UNIT - V			
	6	a)	What is the purpose of providing notches in the bucket of a Pelton wheel? Derive an expression for maximum efficiency in Pelton wheel.	*CO3*	*PO1*	**10**
		b)	A Francis turbine has a runner of 0.5 m diameter and 7.5 cm wide. Inner diameter is 0.35 m. The effective flow area is 93% of the total blade area. The flow velocity is kept constant. The guide vane angle is 23°,inlet vane angle is 97° and outlet vane angle is 30°. The total head available is 60 m, Hydraulic efficiency is 90% and Overall efficiency is 94%. Calculate the speed, specific speed and the power developed.	*CO3*	*PO2*	**10**

			OR			
	7	a)	With the help of neat sketch explain the construction and working of a Francis Turbine	*CO3*	*PO1*	**10**
		b)	A Kaplan turbine working under a head of 15 m develops 7350 kW. The outer diameter of the runner is 4 m and hub diameter is 2 m. The guide blade angle at the extreme edge of the runner is 30 degree. The hydraulic and overall efficency of the runner are 80% and 85% respectively. If the velocity of the whirl is zero at outlet. Determine (i) Runner vane angle at inlet and outlet, at the extreme edge of the runner. (ii) Speed of the turbine.	*CO3*	*PO2*	**10**

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