U.S.N.										

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

Autonomous Institute Affiliated to VTU

April 2025 Semester End Make-Up Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 23ME5PCTFE/22ME5PCTFE **Max Marks: 100**
Course: Thermal and Fluid Engineering

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.

			CO	PO	Marks
		UNIT - I			
1	a)	Define Turbo machine. With neat sketch, explain the working of a 'Turbo machine'.	CO1	PO1	**06**
	b)	From the performance curves of turbines, it is seen that a turbine of 1 m diameter acting under a head of one meter, develops a speed of 25 rpm. What should be the prototype diameter, if it develops 10000 kW working under a head of 200 m, with a so speed of 150.	CO1	PO2	**07**
	c)	Derive Euler's expression for energy transfer in turbo machines.	CO1	PO1	**07**
		OR			
2	a)	Deduce the relationship for maximum power output of a Pelton Turbine.	CO1	PO1	**10**
	b)	In a Francis turbine the discharge is radial. The blade speed at inlet = 25 m/s. At the inlet tangential component of velocity =18 m/s. The radial velocity of flow is constant and equal to 2.5 m/s. Water flows at the rate of 0.8 m^3/s. The utilization factor is 0.82. Find, i) Euler's head, ii) Power developed, iii) Inlet blade angle, and iv) Degree of reaction (R).	CO1	PO2	**10**
		UNIT - II			
3	a)	In a radial outward flow turbomachine, with no whirl at inlet, the blade speed at the exit is twice that at inlet. Radial velocity is constant throughout. Taking the inlet blade angle as 45^o. Show that the degree of reaction $R=(2+\cot\beta_2)/4$ where β_2 is the blade angle at exit with respect to tangential direction.	CO2	PO1	**10**
	b)	The following data refers to a centrifugal compressor with free air delivered =1200 kg/hr, η_{iso} = 70%, and the suction conditions	CO2	PO2	**10**

			are 1 bar and 290° K. The velocity of air at entry is 60 m/s, total head pressure ratio = 3, mechanical efficiency is 95%. Find the total head, temperature of air at exit, and power required to run the compressor.			
			OR			
	4	a)	Define; i) Surging, ii) Pre-whirl, iii) Choking, iv) Pressure coefficient, and v) Over all pressure ratio of a centrifugal compressor.	*CO2*	*PO1*	**10**
		b)	A centrifugal compressor rotor has inlet radius of 30 cm and exit radius of 60 cm, entry is radial with a component of 60 m/s which is const throughout. The compressor requires 700 kW of power to handle 20 kg of air per second. Find the blade angles at inlet and outlet, if the compressor runs at 5100 rpm. Calculate the width at inlet and outlet if the specific volumes at inlet and outlet are 0.85 m^3/kg and 0.71 m^3/kg respectively. What is the degree of reaction?	*CO2*	*PO2*	**10**
			UNIT - III			
	5	a)	With a neat sketch, explain the terminology of centrifugal pump and pump losses.	*CO2*	*PO1*	**10**
		b)	A centrifugal pump of 100 x 100 mm size has a suction lift of 2.5 m and a delivery lift of 28 m. the suction pipe is 3.5 m long and the delivery pipe is 22 m long. The friction factor = 0.025. Water enters radially and the outlet vane angle is 26°. Calculate the discharge and the input required, if the hydraulic efficiency is 0.75 and the mechanical efficiency is 0.88. The impeller is 30 cm dia and 2 cm wide with a speed of 1400 rpm.	*CO2*	*PO2*	**10**
			OR			
	6	a)	Define, ‘slip’, ‘slip coefficient’, and ‘NPSH’ of a centrifugal pump.	*CO3*	*PO1*	**06**
		b)	Explain, ‘priming’ and ‘cavitation’ in centrifugal pump.	*CO3*	*PO1*	**08**
		c)	Obtain the expression for minimum starting speed of a pump.	*CO3*	*PO1*	**06**
			UNIT - IV			
	7	a)	Derive exergy balance equation for a steady flow system.	*CO3*	*PO1*	**10**
		b)	Two kg of air at 5 bar 80° C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of the surroundings which is at 1 bar 5°C. For this process determine; i) maximum work, ii) change in availability, and iii) irreversibility. For air consider C_v=0.718 kJ/kg-K, u= C_vT, R=0.287 kJ/kg-K.	*CO3*	*PO2*	**10**

			OR			
	8	a)	Air expands through a turbine from 5 bar 520°C to 1 bar 300°C. during expansion 10 kJ/kg of heat is lost to the surroundings which is at 0.98 bar, 20°C. Neglecting the KE, PE changes, determine per kg of air; i) decrease in availability, ii) maximum work, and iii) irreversibility. Consider, h= C_pT and C_p=1.005 kJ/kg K.	*CO3*	*PO2*	**10**
		b)	Explain second law efficiencies for the following system: i) Turbine, ii) Compressor, iii) Heat exchanger, and iv) Mixing of two fluids.	*CO3*	*PO1*	**10**
			UNIT - V			
	9	a)	Derive an expression for thermal efficiency of 'Dual combustion cycle'.	*CO4*	*PO1*	**10**
		b)	An oil engine with 20 cm bore and 30 cm stroke works on diesel cycle. The initial pressure and temperature of air used are 1 bar 30°C, the cut-off is 10% of the stroke. Find, i) Air standard efficiency, iii) Mean effective pressure, and iii) Power developed by engine, if it works at 400 rpm. Take compression ratio as 16.	*CO4*	*PO2*	**10**
			OR			
	10	a)	Define 'Knocking' and explain the factors that affects knocking.	*CO4*	*PO1*	**10**
		b)	A single cylinder 4-stroke cycle engine works on diesel cycle have following readings when running at full load. Area of indicator 3 cm^2, length of diagram 4 cm, spring constant= 10 bar/cm, N= 400 rpm, brake load = 380 N, spring reading is 50 N, dia of brake drum = 120 cm, fuel consumption = 2.8 kg/hr, C_V = 42,000 kJ/kg. Diameter of the cylinder = 16 cm, Stroke of the piston = 20 cm. Find, i) Frictional power, ii) Mechanical efficiency, iii) Brake thermal efficiency, and iv) Brake mean effective pressure.	*CO4*	*PO2*	**10**

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