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: 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.

		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 is 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)	What is the purpose of providing notches in the bucket of Pelton wheel? Derive an expression for maximum efficiency in Pelton wheel.	*CO2*	*PO1*	**10**
		OR			
2	a)	Derive an expression for Euler turbine equation and obtain its alternative form.	*CO1*	*PO1*	**10**
	b)	A Francis turbine has a runner 0.5 m in 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 of the turbine.	*CO2*	*PO2*	**10**
		UNIT-II			
3	a)	Derive an expression for over all pressure ratio in a Centrifugal compressor.	*CO2*	*PO1*	**06**
	b)	Explain the phenomenon of surging in centrifugal compressor with the help of neat graph.	*CO2*	*PO1*	**04**
	c)	Initial conditions of 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	*CO2*	*PO2*	**10**

			12 cm. Assume 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.			
			UNIT - III			
	4	a)	With the help of neat schematic diagram of the centrifugal pump. Discuss the different pressure heads associated with it. Explain the Manometric head and Manometric efficiency of the pump.	*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 a speed of 1500 rpm. The velocity of flow is maintained constant at 2.4 m/s and blades are curved backwards at 30 degree to tangent at the 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)	Calculate the decrease in available energy, when *25* kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and the temperature of the surroundings being 15°C (Specific heat of water= 4.2 kJ/kg K).	*CO3*	*PO2*	**10**
		b)	Derive an expression for Exergy balance equation for closed and open system	*CO3*	*PO1*	**10**
			UNIT - V			
	6	a)	Derive an expression for thermal efficiency of an Otto cycle. Draw the P-v and T-s diagram for Otto cycle.	*CO4*	*PO1*	**10**
		b)	In an air standard Diesel cycle, the compression ratio is 15 and the fluid properties at the beginning of compression are 100 kpa and 300K. For a peak temperature of 1600 K. Calculate the percentage of stroke at which the cut off takes place, the thermal efficiency and the work done/ kg of air.	*CO4*	*PO2*	**10**
			OR			
	7	a)	Explain the phenomena of Knocking and detonation in SI engine with help of pressure vs crank angle diagrams. Also highlight the effects of detonation.	*CO4*	*PO1*	**10**
		b)	A Four cylinder, four stroke cycle petrol engine has a stroke of 95 mm and cylinders of 64.5 mm diameter. The volume ratio of compression is 7.5:1. When running at 42 rev/s, the engine consumes 6.5 kg of petrol per hour, the petrol has a calorific value of 44200 kJ/kg. The brake power developed is 16.5 kW. Determine: i. The brake thermal efficiency ii. The cylinder clearance volume iii. Brake mean effective pressure.	*CO4*	*PO2*	**10**

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