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

Autonomous Institute Affiliated to VTU

April 2024 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 23IM3ESEPS **Max Marks: 100**
Course: Elements of Power Systems

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 closed system, open system, intensive property and extensive property	*CO1*	*PO1*	**04**
	b)	Two Celsius thermometers A and B agree at ice point and steam point. The thermometers are related by the equation is $T_A = L + MT_B + NT_B^2$, T_A and T_B are thermometer readings and where L, M and N are constants. When both are immersed in an oil bath, thermometer A indicates 51°C and B indicates 50°C. Determine the reading of A when thermometer B reads 25°C.	*CO2*	*PO2*	**08**
	c)	A cylinder contains 1 kg of certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to a law $PV^2 = C$ until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position; heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid, for an initial volume of 0.5 m^3.	*CO2*	*PO2*	**08**
		UNIT - II			
2	a)	Prove that energy is property of the system	*CO1*	*PO1*	**04**
	b)	A fluid system contained in a piston and cylinder machine, passes through a complete cycle of four processes. The sum of all heat transferred during a cycle is -170 kJ. The system completes 100 cycles per minute. Complete the following table showing the method for each item and compute the net rate of work output in kW.	*CO2*	*PO2*	**08**

Process	Q (kJ/min)	W (kJ/min)	ΔU (kJ/min)
1-2	0	2170	-
2-3	21000	0	-
3-4	-2100	-	-36600
4-1	-	-	-

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		c)	Centrifugal pump delivers 60 kg of water per second. The inlet and outlet pressure are 10 kPa and 400 kPa respectively. The suction is 2 m below and delivery is 8 m above the Centre line of the pump. The suction and delivery pipe diameter are 0.2 m and 0.1 m respectively. Determine the capacity of the electric motor to run the pump.	*CO2*	*PO2*	**08**
			UNIT - III			
	3	a)	Define Kelvin-Planck and Clausius statements	*CO1*	*PO1*	**04**
		b)	Three Carnot heat engines are connected in series. The first engine takes 4000 kJ of heat from a source at 2000 K and delivers 1800 kJ of work, the second and third engines deliver 1200 kJ and 500 kJ of work respectively. Calculate exhaust temperature and heat rejected by the second and third Carnot engines and efficiencies of each engine.	*CO2*	*PO2*	**08**
		c)	A reversible heat engine operating between two thermal reservoirs at 700^{o}C and 50^{o}C. Engine drives a reversible refrigerator operating between -25^{o}C and 50^{o}C. The heat transfer to the heat engine is 2500 kJ and the network available for the combined cycle is 400 kJ. (i) Determine the heat transferred to the refrigerant and the net heat transferred to reservoir at 50^{o}C.	*CO2*	*PO2*	**08**
			OR			
	4	a)	Derive an expression for air standard efficiency of the Otto cycle.	*CO3*	*PO2*	**10**
		b)	An amount of a perfect gas has initial conditions of volume 1 m^3, pressure 1 bar and temperature 18^{0}C. It undergoes ideal diesel cycle operations, the pressure after isentropic compression being 50 bar and the volume after constant pressure expansion being 0.1 m^3. Calculate the temperatures at the major points of the cycle and evaluate the thermal efficiency of the diesel cycle. Assume $\gamma = 1.4$ and $C_p = 1.005$ kJ/kgK for the gas.	*CO3*	*PO2*	**10**
			UNIT - IV			
	5	a)	Derive an expression for the total pressure and Centre of pressure for vertical surface immersed in a liquid.	*CO4*	*PO2*	**10**
		b)	A wooden block of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is 2m x 1m x 0.8m.	*CO4*	*PO3*	**10**
			UNIT - V			
	6	a)	Derive the Bernoulli's equation using Euler's equation for motion	*CO4*	*PO2*	**10**

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		b)	Water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm^2. Find the intensity of pressure section 2.	*CO4*	*PO3*	**10**
			OR			
	7	a)	Derive an expression for rate of flow of fluid through Orificemeter	*CO4*	*PO2*	**10**
		b)	An oil of specific gravity 0.8 is flowing through a Venturimeter having inlet diameter of 0.2 m and throat diameter is 0.1 m. The oil-mercury differential manometer shows a reading of 0.25 m. Calculate the discharge of oil through the horizontal Venturimeter. Take C_d = 0.98 and specific gravity of mercury is 13.6.	*CO4*	*PO3*	**10**

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