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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: MP303

Course Name: THERMAL ENGINEERING (PE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks. Marks

1 a) State Clausius statement of second law of thermodynamics. Show that COP of a heat pump is greater than a refrigerator. (4)

b) Determine the power required to drive a pump which raises the water pressure from 1 bar at the entry to 25 bar at the exit and delivers 2000kg/hr of water. Neglect the changes in volume, elevation and velocity and assume the specific volume of water to be 0.001045 m^3/kg. (6)

2 a) Explain increase of entropy principle. (4)

b) A lump of steel of mass 8 kg at 1000 K is dropped in 80 kg of oil at 300 K. The specific heat of steel and oil are 0.5 kJ/kg.K and 3.5 kJ/kg.K respectively. Calculate the entropy change of steel, oil and universe. (6)

3 a) Sketch a Carnot cycle in a T-S plane and obtain the relationship to calculate the thermal efficiency of a Carnot heat engine. (6)

b) The relationship between pressure and volume in a non-flow process is prescribed by the expression: $p = (3/V) + 2$, where pressure p is in bar and the volume V is in m^3. During the process 1600 kJ of heat is added to the gas and the volume changes from 1.2 m^3 to 4 m^3. Determine the change in internal energy. (6)

4 a) Derive the expression for availability of a closed system. (4)

b) 0.2 kg of air initially at 575K temperature receives 300 kJ of heat reversibly at constant pressure. Determine the available and unavailable energies of the heat added. Take Cp of air as 1.005kJ/kg.K and ambient temperature as 300K. (6)

PART B

Answer any three full questions, each carries 10 marks.

5 a) Sketch a T-S diagram of a pure fluid showing essential features. (5)

b) Define (i) quality of steam. (ii) saturation pressure (iii) subcooled liquid (iii) critical point (v) superheated vapor (5)

6 Write and explain Vander waals Equation of state. The Vander waals constants a and b for ammonia are 422.546 x 10^{-3} $Pa.(m^3/mol)^2$ and 37 x 10^{-6} m^3/mol respectively. Determine the value of critical pressure and critical temperature of ammonia. (10)

7 a) What is the difference between wet bulb temperature and thermodynamic wet bulb temperature. (5)

b Show that specific humidity of moist air is a function of partial pressure of water vapour. (5)

8	a)	Sketch a psychrometric chart and mark all the salient features.	(6)
	b)	What is relative humidity? What is the significance of RH becomes 1?	(4)

PART C

Answer any four full questions, each carries 10 marks.

9		Derive one dimensional heat conduction equation with no heat generation. What is thermal diffusivity of a material?	(10)
10		Hot air at a temperature of 60 °C is flowing through a steel pipe of 10 cm diameter. The pipe is covered with two layers of insulating materials of thickness 5 cm and 3 cm and their corresponding thermal conductivities are 0.23 and 0.37 W/m.K respectively. The inside and outside heat transfer coefficients are 58 and 12 W/m^2 K. The ambient temperature is 25°C. Find the rate of heat loss from a 50 m length of pipe. Neglect the resistance of steel pipe.	(10)
11	a)	What is the difference between natural convection and forced convection?	(5)
	b)	How is heat transfer coefficient defined? What is its unit?	(5)
12		State and explain Stefan- Boltzmann law. Find the total black body emissive power of a 20 cm diameter spherical ball at 800 K.	(10)
13	a)	Draw the temperature profile of a parallel and counter flow heat exchanger.	(5)
	b)	Derive the expression of LMTD for a counter flow heat exchanger.	(5)
14	a)	What is (i) absorptivity (ii) reflectivity (iii) transmissivity.	(6)
	b)	What is Wein's displacement law?	(4)

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