DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

End Semester Examination – Winter 2018

Course: B. Tech in Mechanical Engineering | **Sem:** III

Subject Name: Thermodynamics | **Subject Code:** BTMEC305

Max Marks: 60 | **Date:** 10 Dec 2018 | **Duration:** 3 Hr.

Instructions to the Students:

1. *Solve **ANY FIVE** questions out of the following six questions.*
2. *The level question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in ( ) in front of the question.*
3. *Use of non-programmable scientific calculator is allowed.*
4. *Assume suitable data wherever necessary and mention it clearly.*

		(Level/ CO)	Marks
Q. 1	**Solve the following:**		
A)	State Zeroth law of thermodynamics. Differentiate between point functions & path functions and write at least two examples of each.	(CO-1)	**6**
B)	With the help of simple diagram, explain working principle of thermocouple and state its advantages. A platinum resistance thermometer has a resistance of 2.8 ohm at 0°C and 3.8 ohm at 100°C. Calculate the temperature when the resistance indicated is 5.8 ohm.	(CO-1)	**6**
Q.2	**Solve the following:**		
A)	Show that energy is a property of a system. Differentiate between intensive and extensive properties. State any two intensive and extensive properties.	(CO-2)	**6**
B)	A steam at 18 bar and 400°C (h_1=3251.6, v_1 = 0.16849 m^3/kg) steadily enters a nozzle whose inlet area is 0.02 m^2. The mass flow rate of steam through nozzle is 5 kg/s. Steam leaves nozzle at 14 bar with a velocity of 275 m/s. The heat loss from nozzle is estimated to be 14 kJ/s. Determine (a) the inlet velocity of steam (b) specific enthalpy of steam at exit.	(CO-2)	**6**
Q. 3	**Solve the following:**		
A)	Draw schematic diagram of a simple steam power plant. Explain the Carnot heat engine cycle, with the help of T-s diagram with reference to saturation curve, for a simple steam power plant.	(CO-2)	**6**
B)	An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400 K, rejects 42 MJ at a temperature of 200 K, and delivers 15 kWh of work. Check the validity of the inventors claim. Represent this heat engine with the help of simple schematic diagram.	(CO-2)	**6**
Q.4	**Solve Any ONE of the following:**		
A)	Show that the adiabatic mixing on two fluids is irreversible process. Two kg of water at 80°C is mixed adiabatically with three kg of water at 30°C at atmospheric pressure. Find increase in entropy due to mixing process. State the assumptions made, if any.	(CO-2)	**12**
B)	Show that heat transfer process through a finite temperature difference is irreversible. Water is heated at a constant pressure of 7 bar. The boiling point of water is 165°C. The initial temperature of water is 0°C. The latent heat of evaporation is 2066.3 kJ/kg. Find the increase of entropy of water, if the final state is dry saturated steam.	(CO-2)	**12**

Q. 5 Solve the following:

Exhaust gases from a gas turbine are used to heat water in an adiabatic counter-flow heat exchanger. The gases are cooled from 260°C to 120°C, while water enters at 65°C. The flow-rates of gas and water are 0.38 kg/s and 0.5 kg/s respectively. (CO-4) **12**

Calculate gain in unavailable energy (exergy loss) due to heat transfer process (Take: Cp_g=1.09 kJ/kg K, Cp_w= 4.187 kJ/kg K, T_0 = 25°C)

Q. 6 Solve the following:

A) A closed system of 2 kg of air initially at pressure of 5 bar and 227°C expands polytropically to a pressure of 2 bar following the law of $PV^{1.25}$ = constant. (CO-3) **6**

(a) Determine work done & heat transfer.

(b) State assumptions made.

B) Explain, with the help of simple sketch, the principle of throttling calorimeter. Explain with the help of h-s diagram, why a throttling calorimeter cannot measure the quality of very wet steam. How is the quality of such a steam measured then? (CO-5) **6**

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