

**MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL**

Paper Code : PC-ME301 Thermodynamics

UPID : 003491

Time Allotted : 3 Hours

Full Marks : 70

*The Figures in the margin indicate full marks.**Candidate are required to give their answers in their own words as far as practicable***Group-A (Very Short Answer Type Question)**

1. Answer any ten of the following :

[1 x 10 = 10]

- (i) Define saturation temperature.
- (ii) Define 1st law of thermodynamics.
- (iii) What is a thermal energy reservoir?
- (iv) Can entropy ever decrease?
- (v) What are the processes involved in Brayton Cycle?
- (vi) What is the definition of Pressure?
- (vii) What is pyrometer ?
- (viii) What is sublimation?
- (ix) Does the amount of mass entering a control volume have to be equal to the amount of mass leaving during an unsteady-flow process?
- (x) What is adiabatic process?
- (xi) Write down three characteristics of Entropy.
- (xii) What are the methods to improve the efficiency of Rankine Cycle?

Group-B (Short Answer Type Question)

Answer any three of the following :

[5 x 3 = 15]

2. How do the energies of a flowing fluid and a fluid at rest compare? Name the specific forms of energy associated with each case. [5]
3. Establish the relation between COP of Refrigerator and Heat Pump. [5]
4. Entropy of a saturated liquid at 227 degree Celsius is 2.6KJ/KG.K and its latent heat of vaporization is 1800KJ/KG, then the entropy of saturated vapor at 227 degree Celsius would be _____. [5]
5. During a regeneration process, some steam is extracted from the turbine and is used to heat the liquid water leaving the pump. This does not seem like a smart thing to do since the extracted steam could produce some more work in the turbine. How do you justify this action? [5]
6. A cylinder contains 0.92kg of steam at 1.5mpa. If the volume of steam 0.1 m³, determine enthalpy and internal energy of steam per kg. [5]

Group-C (Long Answer Type Question)

Answer any three of the following :

[15 x 3 = 45]

7. (a) What is the physical significance of h_{fg} ? Can it be obtained from a knowledge of h_f and h_g ? How? [5]
(b) What is quality? Does it have any meaning in the superheated vapor region? [5]
(c) Can quality be expressed as the ratio of the volume occupied by the vapor phase to the total volume? Explain. [5]
8. (a) Would you expect the temperature of air to drop as it undergoes a steady-flow throttling process? Explain. [5]
(b) Would you expect the temperature of a liquid to change as it is throttled? Explain. [5]
(c) Helium is contained in a 2m³ rigid volume at 50 degree Celsius and 200Kpa. Calculate the heat transfer needed to increase the pressure to 800kpa. [5]
9. (a) The drinking water needs are met by cooling tap water in a refrigerated water fountain from 23 to 6 degree Celsius at an average rate of 10 kg/h. If the COP of the refrigerant is 3.1, the required power input to this refrigerator is _____. [5]

- (b) Is it possible for a heat engine to operate without rejecting any waste heat to a low-temperature reservoir? Explain. [5]
- (c) Consider a pan of water being heated (a) by placing it on an electric range and (b) by placing a heating element in the water. Which method is a more efficient way of heating water? Explain. [5]
10. (a) A lump of steel weighing 30kg at a temperature of 427 degree Celsius is dropped in 150kg of oil at 27 degree Celsius. The specific heats of steel and oil are 0.46kj/kg.k and 2.5 KJ/KG.K respectively. Estimate the entropy change of steel, the oil and the system containing oil and lump of steel in KJ/K. [8]
- (b) Is an isothermal process necessarily internally reversible? Explain your answer with an example. [5]
- (c) Is it possible to create entropy? Is it possible to destroy it? [2]
11. (a) Two different fuels can be used in a heat engine operating between the fuel burning temperature and a low temperature of 350K. Fuel A burns at 2500K delivering 52000KJ/KG and costs 1.75 per Kg. Fuel B burns at 1700K delivering 40000KJ/KG and costs 1.50 per kg. Which fuel do you use and why ? [7]
- (b) A mechanic claims to have developed a car engine that runs on water instead of gasoline. What is your response to this claim? [4]
- (c) Describe an imaginary process that satisfies the first law but violates the second law of thermodynamics. [4]

*** END OF PAPER ***