INDIAN MARITIME UNIVERSITY
Time Bound Assignment
B Tech (ME) Arrear Examinations
September/October 2020
UG11T3103
Basic Thermodynamics

Date: 12/09/2020	Max Marks: 70
Duration: 3 Hrs	Pass Marks: 35

Note: Use of Steam/ Property tables, charts & calculator is permitted.

Part – A (compulsory)
Answer the following (10x2=20 Marks)

1. What is property of a system? Give four examples.

2. What do you mean by system, surrounding & boundary?

3. What is 'Dryness fraction' of vapour?

4. Write Characteristic equation of state for a perfect gas. Mention each term with relevant unit.

5. Draw P-V diagram for an isobaric process & derive expression for its boundary work.

6. Write expression for total energy of flowing fluid detailing each term.

7. What is thermal reservoir? Describe its types in brief.

8. What is entropy? State principle of increasing entropy.

9. Write expression for exergy of kinetic energy & potential energy.

10. Express relation between exergy destruction & entropy generation.

Part – B
Answer any 5 out of 7 questions (5 x 10= 50 marks)

11. (a) Describe different types of system with example. **(5 marks)**

(b) A system receives 5 kJ of heat transfer and experiences a decrease in energy in the amount of 5 kJ. Determine the amount of work done by the system. **(5 marks)**

12. (a) Draw T-v diagram of a pure substance undergoing phase change showing all details. **(5 marks)**

(b) A rigid tank contains 10 kg of water at 90^0C. If 8 kg of water is in liquid form & rest in vapour form, determine (a) the pressure in

tank & (b) the volume of tank. Consider at 90°C, P_{sat} =70.183 kPa, v_f=0.001036 m^3/kg & v_g= 2.3593 m^3/kg. **(5 marks)**

13. (a) Explain Gibbs Phase Rule? **(5 marks)**

(b) An ideal gas having an initial temperature of 25°C under goes two processes as described below:
Process 1-2: The volume is held constant while the pressure doubles.
Process 2-3: The pressure is held constant while the volume is reduced to one-third of the original volume.
Draw P-V diagram & determine final temperature of the gas.
(5 marks)

14. (a) Define specific heat C_P & C_v. Derive relation $C_p = C_v + R$. **(5 marks)**

(b) Saturated steam at 0.4 MPa is throttled to 0.1 MPa, 100°C in a steady-state steady-flow process adiabatically. Determine the quality of the steam at 0.4 MPa, neglecting kinetic & potential energies. Consider $h_{@\ P=0.1MPa\ \&\ 100°C} = 2675.8 \frac{kJ}{kg}$,
$h_{f\ @\ P=0.4MPa} = 604.66 \frac{kJ}{kg}$ and $h_{fg@P=0.4\ MPa} = 2133.4 \frac{kJ}{kg}$. **(5 marks)**

15. (a) Describe Carnot cycle. Draw P-v diagram & describe all processes.
(5 marks)

(b) An inventor claims to have developed a refrigerator that maintains the refrigerated space at 2°C while operating in a room where the temperature is 25°C and has a COP of 13.5. Is there any truth to his claim? Explain. **(5 marks)**

16. (a) Derive first and second Tds relation of entropy. **(5 marks)**

(b) 0.04 m^3 of nitrogen contained in a cylinder behind a piston is initially at 1.05 bar & 15°C. The gas is compressed isothermally and reversibly until the pressure is 4.8 bar. Calculate the change of entropy in this process. Assume nitrogen to act as perfect gas & Molar mass of nitrogen is 28 kg/kmol. **(5 marks)**

17. (a) What is Second-Law efficiency? Describe. **(5 marks)**

(b) A heat engine receives heat from a source at 1200 K at a rate of 500 kJ/s and rejects waste heat to a medium at 300 K. The power output of heat engine is 180 kW. Determine the reversible power & the irreversibility rate for this process.
(5 marks)

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