INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

End Semester Examination Dec-2019/Jan-2020

B. Tech (Marine Engineering)

Semester-II

Basic Thermodynamics

(UG11T3103)

Date: 14/12/2019 Maximum marks: 70

Time: 3 Hrs Pass Marks: 35

Note: Use of steam table is allowed

PART-A (Marks: 10×2 = 20)

(All Questions are compulsory)

1. Describe Extensive and Intensive properties with examples.

2. Define system, surrounding & boundary.

3. What do you mean by 'Quality' of steam?

4. Define compressibility factor.

5. Derive an expression for boundary work of an isothermal process for an ideal gas.

6. What is mass flow rate? Write an expression for it & describe each term with unit.

7. State Carnot Principles.

8. Derive first Tds relation of entropy.

9. Define Exergy and Dead state?

10. Describe 'decrease in exergy principle'

PART-B (Marks: 5×10 = 50)

(Answer any 5 of the following 7 Questions)

11. a) Explain Point function & Path function with example (4)

b) A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of fluid is 800 kJ. During the cooling process, the fluid loses 500 kJ of heat & the paddle wheel does 100 kJ of work on fluid. Determine final internal energy of fluid. (6)

12. a) What is pure substance? Draw T-v diagram of a pure substance showing phase change. (4)

b) Find dryness fraction, specific volume & specific internal energy of steam at 7 bar and enthalpy 2550 kJ/kg. (6)

13. a) What is Gibbs Phase Rule? Explain. (4)

b) A 1 m^3 tank containing air at 25°C and 500 kPa is connected through a valve to another tank containing 5 kg of air at 35°C and 200 kPa. Now the valve is opened, and the entire system is allowed to reach thermal equilibrium with the surroundings, which are at 20°C. Determine the volume of the second tank and the final equilibrium pressure of air. Assume R_{air} = 0.287 kPa.m^3/ kgK (6)

14. a) What do you mean by specific heat C_P & C_v? Prove that $C_p = C_v + R$. (4)

b) Steam at 0.4 MPa, 300°C, enters an adiabatic nozzle with a low velocity and leaves at 0.2 MPa with a quality of 90%. Find the exit velocity, in m/s. (6)

15. a) Write both statements of Second Law of Thermodynamics. What are major uses of this law? (4)

b) A cyclic heat engine operates between a source temperature of 800^0C and a sink temperature of30^0C. What is the least rate of heat rejection per kW net output of the engine? (6)

16. a) Prove that for isentropic processes of an ideal gas, pV^{γ}=Constant. (4)

b) Steam at 7 MPa & 450^0C is throttled in a valve to a pressure of 3 MPa during a steady flow process. Determine the entropy generated during this process. (6)

17. a) What is Reversible work & Irreversibility? (4)

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. (6)

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