Indian Maritime University

(A Ce6ntral University, Govt of India)

End Semester Examinations – June 2025

Programme Name: B Tech (Marine Engineering)

Semester: II

Subject Code: UG11T5203

Subject Name: THERMODYNAMICS

Date: 10.06.2025	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

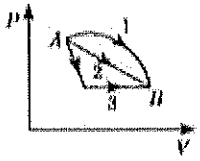
General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.
(iii) Thermodynamic Property Tables (Steam/Refrigerant/Air Properties) can be used.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. An ideal gas goes from state A to state B via three different processes, as indicated in the P-V diagram. If Q1, Q2, Q3 indicates the heat absorbed by the gas along the three processes and ΔU1, ΔU2, ΔU3 indicates the change in internal energy along the three processes respectively, then:



(a) Q1 > Q2 > Q3 ; ΔU1 = ΔU2 = ΔU3
(b) Q3 > Q2 > Q1 ; ΔU1 = ΔU2 = ΔU3
(c) Q3 = Q2 = Q1 ; ΔU1 > ΔU2 > ΔU3
(d) Q3 = Q2 = Q1 ; ΔU1 < ΔU2 < ΔU3

2. On the phase diagram of pure substance, the superheated region is marked where the substance:

(a) is in vapor state and its temperature is above boiling point
(b) is in liquid state and its temperature is below boiling point
(c) exists in both vapor and liquid state
(d) exists neither as gas nor liquid

3. Steady flow occurs when
(a) conditions do not change with time at any point
(b) conditions are the same at adjacent points at any instant
(c) conditions change steadily with the time
(d) $\partial v/\partial t$ is constant

4. Which of the following is a path function

(a) Pressure

(b) Temperature

(c) Volume

(d) Work

5. An isentropic process is always
(a) irreversible and adiabatic (b) reversible and isothermal
(c) frictionless and irreversible (d) reversible and adiabatic

6. During throttling process
(a) internal energy does not change (b) pressure does not change
(c) entropy does not change (d) enthalpy does not change

7. If the temperature of the source is increased, the efficiency of the Carnot engine
(a) decreases (b) increases (c) does not change (d) will be equal to the efficiency of a practical engine

8. For an irreversible process, the entropy change of the system plus surroundings:

(a) Is always zero

(b) Decreases

(c) Increases

(d) Cannot be determined

9. For same compression ratio
(a) thermal efficiency of Otto cycle is greater than that of Diesel cycle
(b) thermal efficiency of Otto cycle is less than that of Diesel cycle
(c) thermal efficiency of Otto cycle is same as that for Diesel cycle
(d) thermal efficiency of Otto cycle cannot be predicted.

10. The thermal efficiency of theoretical Otto cycle
(a) increases with increase in compression ratio
(b) increases with increase in isentropic index γ
(c) does not depend upon the pressure ratio
(d) follows all the above

Section B

Five Questions of 02 Marks each

11. Why does the liquids and solids have a single specific heat?
12. Define intensive and extensive properties.
13. Define pure substance and explain the concept of phase diagram of a pure substance.
14. An inventor claims to have developed an engine running between 900 K and 300 K. It takes 1500 kJ of energy and develops 1200 kJ of work. Evaluate the claim.
15. Draw P-V diagram for an ideal dual cycle.

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. A piston–cylinder device contains 50 kg of water at 250 kPa and 25°C. The cross-sectional area of the piston is 0.1 m^2. Heat is now transferred to the water, causing part of it to evaporate and expand. When the volume reaches 0.2 m^3, the piston reaches a linear spring whose spring constant is 100 kN/m. More heat is transferred to the water until the piston rises 20 cm more. Determine (a) the final pressure and temperature and (b) the work done during this process.

17. (a) Derive expression for boundary work in polytropic process (4 marks)
(b) 3 kg of Air initially at 310 K expands in a piston-cylinder device at a constant pressure of 5 bar from 0.1 m^3 to 0.3 m^3. Find the final temperature and work done (6 Marks)

18. (a) Derive an expression for the entropy of a closed system (4 Marks)
(b) 30 kg air is heated in a rigid tank from 2 bar 300K to 20 bar. In this process, 80 % of the heat is lost to the surroundings. Find the change in entropy of the universe. (6 Marks)

19. Two Carnot refrigerators are working in series between the source and sink temperatures of 550 K and 350 K. If both refrigerators consume equal power input, determine the (a) intermediate temperature, (b) COP of refrigerator connected to sink, (c) heat rejected by refrigerator connected to source, if heat removed from sink at a rate of 100 kJ/s.

20. Saturated steam at a pressure of 2 MPa 350°C undergoes an isentropic expansion in a turbine until the pressure drops to 10 kPa. Calculate the final temperature of the steam and work done during the process.

21. Derive an expression for thermal efficiency of ideal otto cycle.

22. Discuss the following (a) State Postulate (b) Zeroth law of thermodynamics (c) Reversible Process (d) Irreversible Process (2.5+2.5+2.5+2.5 Marks)