

Indian Maritime University
(A Central University, Govt of India)

Mar/Apr 26 SE

Programme Name: B Tech (Marine Engineering)

Semester: Second Semester

Subject Code: UG11T5203

Subject Name: Thermodynamics

Date: 13.03.2026

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) Steam Tables can be used
- (iv) Calculators allowed

Section A

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

1. What is the most evident implication of the Zeroth Law of Thermodynamics?
 - A) The creation of a temperature scale
 - B) The determination of heat capacity
 - C) The principle of conservation of mass
 - D) The efficiency of a Carnot engine
2. Which of the following is a path function
 - A) Pressure
 - B) Temperature
 - C) Volume
 - D) Work
3. In thermodynamics, boundary work is said to be done when:
 - A) There is a change in volume
 - B) There is a change in kinetic energy
 - C) There is a change in potential energy
 - D) There is no transfer of energy

4. In the polytropic process equation $pV^n = \text{constant}$, if n is infinitely large, the process is termed as

- A) constant volume
- B) constant pressure
- C) constant temperature
- D) adiabatic

5. During a compression process in a closed system, if no heat is transferred to the surroundings, the system's temperature:

- A) Will always increase
- B) Will always decrease
- C) May either increase or decrease depending on the gas properties
- D) Will remain constant

6. Shaft work in thermodynamics is associated with:

- A) The energy transferred during the motion of a piston in a cylinder
- B) The energy transferred via the motion of a rotating shaft
- C) The energy transferred in free expansion of a gas
- D) The total change in internal energy of a system

7. Which of the following is not an example of an irreversible process?

- A) Heat flow from a hot body to a cold body
- B) Mixing of two gases
- C) A frictionless, perfectly insulated expansion of gas
- D) combustion of fuel

8. Which if the following is not true about second law of thermodynamics

- A) it gives the idea of a heat engine
- B) it defines irreversibility and entropy
- C) it conceptualizes refrigerator
- D) it proposes law of conservation of energy

9. For an irreversible process, the entropy change of the universe:

- A) Is always zero
- B) Decreases
- C) Increases
- D) Cannot be determined

10. 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
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- C) exists in both vapor and liquid state
D) exists neither as gas nor liquid

Section B

Five Questions of 02 Marks each

11. Why do liquids and solids have a single specific heat?
12. Define intensive and extensive properties.
13. Apply steady flow energy equation for a nozzle and deduce nozzle equation
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) 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 m³ to 0.3 m³. find the final temperature and work done 6 Marks
17. Derive an expression for thermal efficiency of ideal otto cycle. 10 Marks
18. A rigid tank contains 10 kg of water at 90°C. If 8 kg of the water is in the liquid form and the rest is in the vapor form, determine (a) the pressure in the tank and (b) the volume of the tank. 10 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. 10 Marks
20. 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

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21. 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. 10 Marks

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)

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