

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

Sep/Oct'25 SE

Programme Name: B Tech (Marine Engineering)

Semester: Second Semester

Subject Code: UG11T5203

Subject Name: Thermodynamics

Date: 10.09.2025

Maximum Marks: 70

Duration: 03 hours

Passing 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 and Mollier Diagram can be used.

Section A

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

1. For the same compression ratio, the efficiency of dual combustion cycle is
 - a) greater than Diesel cycle and less than Otto cycle
 - b) less than Diesel cycle and greater than Otto cycle
 - c) greater than both Diesel cycle and Otto cycle
 - d) less than both Diesel cycle and Otto cycle

2. For reversible adiabatic process, change in entropy is
 - a) greater than zero
 - b) less than zero
 - c) is equal to zero
 - d) infinite

3. In constant pressure thermometer, which among the following is thermometric property
 - a) pressure
 - b) volume
 - c) length
 - d) e.m.f.

4. For isothermal process, the first law of thermodynamics is represented by (δQ is the heat exchange, δW is the work done and dU is its change in internal energy)
 - a) $\delta Q = \delta W$
 - b) $\delta Q = dU$
 - c) $\delta Q = dU - \delta W$
 - d) $\delta Q = dU + \delta W$

5. Which among the following is not path functions

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

16. a) Discuss the following (i) State Postulate (ii) Zeroth law of thermodynamics (5 marks)
- b) What do you understand by thermodynamic equilibrium? List and explain various types of equilibrium? (5 marks)
17. A piston-cylinder device, whose piston is resting on a set of stops, initially contains 3 kg of air at 200 kPa and 27°C. The mass of the piston is such that a pressure of 400 kPa is required to move it. Heat is now transferred to the air until its volume doubles. Determine the work done by the air and show the process on a P - v diagram. Assume $R = 0.287$ kJ/kg-K and $C_v = 0.718$ kJ/kg-K (10 marks)
18. A heat engine operating between two reservoirs at 627 °C and 27 °C is used to drive a heat pump which extracts heat from the reservoir at 27 °C at a rate twice that at which the engine rejects heat to it. If the efficiency of the engine is 30% of the maximum possible and the COP of the heat pump is 40% of the maximum possible, what is the temperature of the reservoir to which the heat pump rejects heat? What is the rate of heat rejection from the heat pump if the rate of heat supply to the engine is 60 kW? (10 marks)
19. Air at 1.02 bar, 22°C, initially occupying a cylinder volume of 0.015 m³, is compressed reversibly and adiabatically by a piston to a pressure of 6.8 bar. Calculate: (i) The final temperature; (ii) The final volume; (iii) The work done. (10 marks)
20. a) A rigid tank contains 20 kg of water at 80 °C. If 12 kg of water is in liquid form and the rest is in the vapour form, determine the specific volume of the water in the tank? (3 marks)
- b) One kg of ice at -10°C is exposed to the atmosphere which is at 40°C. The ice melts and comes into thermal equilibrium with the atmosphere. Calculate the total entropy change of the universe? c_p of ice is 2.093 kJ/kg-K. the latent heat of fusion of ice is 333.3 kJ/kg and c_p of water is 4.18 kJ/kg-K. (7 marks)
21. Derive the Steady Flow Energy Equation (SFEE), and using SFEE write an equation for the work input for running a compressor. (10 marks)

22. In an Otto engine, pressure and temperature at the beginning of compression are 1 bar and 27 °C respectively. Calculate the theoretical thermal efficiency of this cycle if the pressure at the end of the adiabatic compression is 14 bar. Peak temperature during the cycle is 1727 °C. Take $c_v = 0.717$ kJ/kg K and $\gamma = 1.4$. Calculate i) the heat supplied per kg of air, ii) the work done per kg of air and iii) the pressure at the end of adiabatic expansion.

(10 marks)

TAM