Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2026

Programme Name: B.Tech (Marine Engineering)

Semester: II

Subject Code: UG11T5203

Subject Name: Thermodynamics

Date: 05.06.2026	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) Thermodynamic Property Tables can be used.

Section A

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

1. 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.

2. Which of the following is an example of a closed system?
(a) Steam flowing through a turbine
(b) Gas in a sealed piston-cylinder device
(c) Water flowing in a pipe
(d) Air compressor

3. A frictionless heat engine can be 100% efficient only if its exhaust temperature is
(a) equal to its input temperature (b) less than its input temperature
(c) 0°C (d) 0°K

4. Kelvin–Planck statement says it is impossible to construct a heat engine that:
(a) Converts heat completely into work (b) Converts work into heat
(c) Transfers heat between reservoirs (d) Produces work with friction

5. Which of the following statement/s are true
(a) Entropy of system always increases
(b) Entropy of surroundings always increases
(c) Entropy of universe always increases
(d) All the above

6. Boundary 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 thermodynamic properties remains constant during an ideal throttling process?
(a) Entropy (b) Temperature (c) Enthalpy (d) Pressure

8. The latent heat of vapourisation at critical point is
(a) less than zero (b) greater than zero (c) equal to zero (d) none of the above.

9. With increase in pressure
(a) enthalpy of dry saturated steam increases
(b) enthalpy of dry saturated steam decreases
(c) enthalpy of dry saturated steam remains same
(d) enthalpy of dry saturated steam first increases and then decreases.

10. Steam heated above its saturation temperature at a given pressure is called:

(a) Wet steam (b) Saturated steam

(c) Superheated steam (d) Compressed steam

Section B

Five Questions of 02 Marks each

11. A fixed mass of an ideal gas is heated from 50 to 80°C at a constant pressure of (a) 1 atm and (b) 3 atm. For which case do you think the energy required will be greater? Why?

12. Differentiate between nozzle and diffuser.

13. The food compartment of a refrigerator is maintained at 4°C by removing heat from it at a rate of 360 kJ/min. If the required power input to the refrigerator is 2 kW, determine the coefficient of performance.

14. Explain the difference between heat engine, refrigerator and heat pump

15. Draw T-S diagram for air standard dual cycle.

Section C

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

16. Derive an expression for thermal efficiency of ideal diesel cycle. 10 Marks

17. a) 1.5 kg air undergoes an expansion which follows a relationship $p = a + bV$, where a and b are constants. The initial and final pressures are 1000 kPa and 200 kPa, respectively, and the corresponding volumes are 0.20 m^3 and 1.20 m^3. The specific internal energy of the gas is given by the relation $u = 1.5\ pv - 85$ kJ/kg Where p is the kPa and v is in m^3/kg. Calculate the change in internal energy, work done and net heat transfer. 7 Marks

b) Explain the differences between shaft work and boundary work 3 Marks

18. One kg of ice at -5°C is exposed to the atmosphere, which is at 25°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 4.187 kJ/kg-K. 10 Marks

19. Two Carnot Engines A and B are connected in series between two thermal reservoirs. Engine A receives 2000 kJ of heat from the high temperature reservoir maintained at 1400 K and rejects heat to the Carnot engine B. Engine B takes in heat rejected by engine A and rejects heat to the low temperature reservoir maintained at 300 K. If engines A and B have equal thermal efficiencies, determine (a) the heat rejected by engine B, (b) temperature at which heat is rejected by engine A, (c) Calculate the total work done by engine A and B and (d) Overall efficiency of the system. 10 marks

20. Define the following (a) Intensive property, (b) Extensive property, (c) Zeroth law of thermodynamics and (d) State Postulate (2.5+2.5+2.5+2.5 Marks)

21. Determine the change in entropy of universe if a copper block of 1 kg at 150°C is placed in a seawater at 25°C. Take heat capacity of copper as 0.393 kJ/kg K. 10 Marks

22. A piston–cylinder device, with a set of stops on the top, initially contains 3 kg of air at 200 kPa and 27°C. Heat is now transferred to the air, and the piston rises until it hits the stops, at which point the volume is twice the initial volume. More heat is transferred until the pressure inside the cylinder also doubles. Determine the work done and the amount of heat transfer for this process. 10 Marks