

Indian Maritime University
(A Central University, Govt of India)
Supplementary Examinations – March/April 2025
Programme Name: B Tech (ME)
Semester: III
Subject Code: UG11T4304
Subject Name: Applied Thermodynamics

Date: 25.03.2025

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) Steam/Air tables can be used.

Section A

Ten MCQs of 01 Mark each – Choose the correct answer as applicable.

1. For same compression ratio

- (a) Thermal efficiency of Otto cycle is greater than that of Diesel cycle
- (b) Thermal efficiency of Diesel cycle is greater than that of the Otto cycle
- (c) Thermal efficiency of Otto cycle is same as that for Diesel cycle
- (d) Thermal efficiency of Otto cycle is less than that of Diesel cycle

2. The ratio of brake power to indicated power of an I.C. engine is called

- (a) Mechanical efficiency
- (b) Thermal efficiency
- (c) Volumetric efficiency
- (d) Relative efficiency

3. In a four stroke cycle engine, the operations namely suction, compression, expansion and exhaust are completed in the number of revolutions of crankshaft equal to

- (a) Two

- (b) One
- (c) Four
- (d) Three

4. The device used to measure the brake power of an engine is known as

- (a) Engine indicator
- (b) Air-box
- (c) Tachometer
- (d) Dynamometer

5. The isentropic expansion through nozzle of superheated steam at inlet is approximated by equation

- (a) $p v = C$
- (b) $p v^{1.3} = C$
- (c) $p v^{1.135} = C$
- (d) $p v^{1.4} = C$

6. Rankine cycle comprises of

- (a) Two isothermal processes and two constant pressure processes
- (b) Two isentropic processes and two isochoric processes
- (c) Two isentropic processes and two isobaric processes
- (d) Two isochoric processes and two isobaric processes

7. The clearance volume in reciprocating air compressors is provided to

- (a) To reduce the work done per kg of air delivered
- (b) To increase the volumetric efficiency of the compressor
- (c) To create turbulence in the air to be delivered
- (d) To allow necessary space for valve operation

8. The value of universal gas constant is

- (a) 8.314 kJ/kmol.K
- (b) 0.287 kJ/kg.K
- (c) 1.4 kJ/kg.K

(d) 1.005 kJ/kg.K

9. Air standard Brayton cycle consists of

- (a) Two isothermal processes and two constant pressure processes
- (b) Two isentropic processes and two isochoric processes
- (c) Two isochoric processes and two isobaric processes
- (d) Two isentropic processes and two isobaric processes

10. Which law explained solubility of gases in a liquid?

- (a) Charles law
- (b) Henry's law
- (c) Raoult's law
- (d) Boyle's law

Section B

Five Questions of 02 Marks each

- 11. State the Amagat's law of partial volumes.
- 12. Draw the Pv and Ts diagrams for the dual cycle.
- 13. Define Free Air Delivered (F.A.D).
- 14. What is a convergent-divergent nozzle?
- 15. Define specific steam consumption.

Section C

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

16.

A. Derive an expression of thermal efficiency for the Diesel cycle. (5 marks)

B. Explain the working of four stroke spark ignition engine. (5 marks)

17. In an air standard Otto cycle the maximum and minimum temperatures are 1400°C and 15°C. The heat supplied per kg of air is 800 kJ. Calculate the compression ratio and the cycle thermal efficiency. Also calculate the ratio of maximum pressure to minimum pressure in the cycle. (10 marks)

18. A single stage reciprocating compressor takes in air at 1 bar and 20°C and delivers it at 6 bar and 180°C. The mass of air delivered is 1.7 kg/min. Assuming that the clearance is negligible, calculate A) the index of compression; B) indicated power; C) F.A.D. (10 marks)

19.

- A.** State two methods of increasing the thermal efficiency of a Rankine cycle. (5 marks)
- B.** Explain the reheat Rankine cycle and its benefits. (5 marks)

20.

- A.** What does the Joule-Thomson coefficient represent? (5 marks)
- B.** Explain the importance of the Henry's law. (5 marks)

21. A vessel of 0.35m^3 capacity contains 0.4 kg of carbon monoxide (molecular weight = 28) and 1 kg of air at 20°C . Calculate: (i) The partial pressure of each component; (ii) the total pressure in the vessel, and the gravimetric analysis of air may be taken as 23.3% oxygen (molecular weight = 32) and 76.7% nitrogen (molecular weight = 28) (10 marks)

22. Estimate the critical pressure and the throat area per unit mass flow rate of a convergent-divergent nozzle expanding steam from 10 bar, dry saturated, down to atmospheric pressure of 1 bar. Assume that the inlet velocity is negligible and that the expansion is isentropic. (10 marks)