Indian M5aritime University

(A Central University, Govt of India)

Sep/Oct'25 SE

Programme Name: B Tech (ME)

Semester: III

Subject Code: UG11T4304

Subject Name: Applied Thermodynamics

Date: 19.09.2025	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 two 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) $pv = C$

(b) $pv^{1.3} = C$

(c) $pv^{1.135} = C$

(d) $pv^{1.4} = C$

6. Which of the following options is correct with regard to a Regenerative Rankine Cycle?

(a) Full mass flow rate multi-staged expansion in turbines

(b) Full mass flow rate multi-staged pumps supplying feed water to boiler

(c) Bleed steam from turbine directly mixing with the condensate

(d) Fraction of the mass flow rate of water through the boiler

7. If the air enters the reciprocating compressor at 2 bar and leaves at 8 bar, the optimal intermediate pressure for two stage compression is :

(a) 3.5 bar

(b) 4.0 bar

(c) 6 bar

(d) 3.0 bar

8. Which law explains solubility of gases in a liquid?

(a) Charles law

(b) Henry's law

(c) Raoult's law

(d) Boyle's law

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. In the Mollier chart the lines of constant temperature are shown in the

(a) wet region

(b) superheated region

(c) saturated region

(d) none of the above

Section B

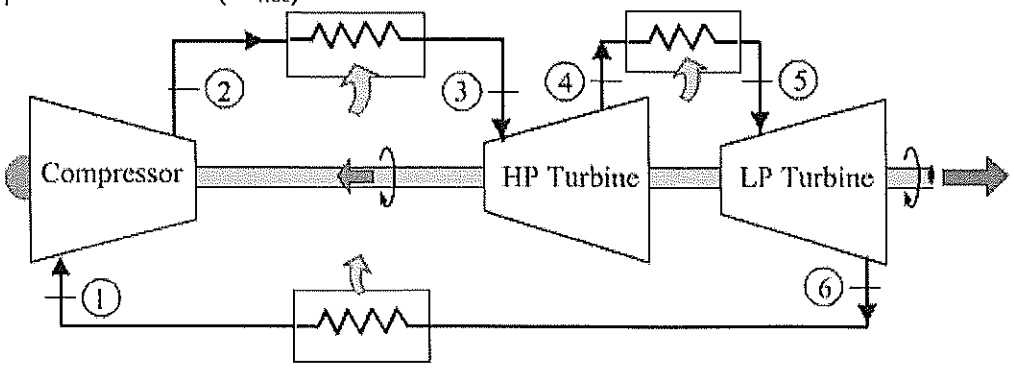
Five Questions of 02 Marks each

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. Air enters the compressor of a simple gas turbine at 0.1 MPa, 300 K. The pressure ratio is 9 and the maximum temperature is 1000 K. The turbine process is divided into two stages each with a pressure ratio of 3, with intermediate reheating to 1000 K. Determine the cycle efficiency (η_{th}) and the net work output per unit mass (W_{net})



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. For a reciprocating internal combustion engine, explain the following:

a. Brake Mean Effective Pressure (BMEP)
b. Mechanical Efficiency
c. Friction power
d. Indicated thermal efficiency
e. Air to fuel ratio

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)