

Indian Maritime University
(A Central University, Govt of India)
End Semester Examinations – December 2023
Programme Name: B. Tech (Marine Engineering)
Semester: III
Subject Code: UG11T4304
Subject Name: APPLIED THERMODYNAMICS

Date: 11.12.2023

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) Usage of Steam tables is allowed

Section A

Ten MCQs/Fill in the Blanks 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. 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
3. _____ is a device used for measuring the torque and brake power
 - (a) Tachometer
 - (b) Dynamometer

- (c) Dickinson-Newell indicator
(d) Ammeter
4. 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
5. $\left(\frac{\partial P}{\partial V}\right)_T \left(\frac{\partial V}{\partial T}\right)_P \left(\frac{\partial T}{\partial P}\right)_V$ is equal to:
- (a) zero
 - (b) 1
 - (c) -1
 - (d) Infinity
6. Which law explains solubility of gases in a liquid?
- (a) Charles law
 - (b) Henry's law
 - (c) Raoult's law
 - (d) Boyle's law
7. 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
8. 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) $p v^{1.4} = C$
9. Propulsive efficiency is defined as the ratio of

- (a) Thrust power and fuel energy
 - (b) Engine output propulsive power
 - (c) Thrust power and propulsive power
 - (d) Propulsive power and fuel input
10. The value of characteristic gas constant of air 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

Section B

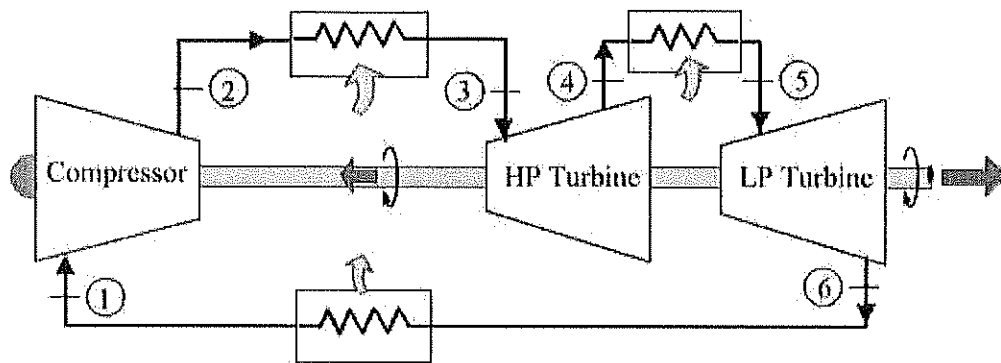
Five Questions of 02 Marks each

- 11. Define specific steam consumption for a steam plant
- 12. State Dalton's Law of partial pressure
- 13. Differentiate between nozzle and diffuser
- 14. Draw the ***P - v*** and ***T - s*** diagrams for the dual cycle
- 15. State the Amagat's law of partial volumes

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. 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.
18. a) How can we increase the efficiency of the Rankine cycle?
 b) Draw the T-s diagram and explain the working of an ideal reheat Rankine cycle.
 (05+05 marks)
19. a) Compare and differentiate between four-stroke and two-stroke engines
 b) Write the advantages of Multistage Compression (05 +05 marks)
20. 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.
21. A single stage double acting air compressor is required to deliver 14m^3 of air per minute measured at 1.013 bar 15°C . The delivery pressure is 7 bar and the speed 300 r.p.m. Take the clearance volume as 5% of the swept volume with the compression and expansion index of $n = 1.3$.
 Calculate: (i) swept volume of the cylinder; (ii) the delivery temperature; (iii) indicated power
22. A small power plant produces 25 kg/s steam at 3MPa, 600°C in the boiler. It cools the condenser with ocean water coming in at 12°C and return at 15°C . Condenser exit is 45°C . Find net power output and required mass of ocean flow water.