Indian Maritime University

(A Central University6, Govt of India)

End Semester Examinations– December 2024

Programme Name: B Tech (ME)

Semester: Three

Subject Code: UG11T4304

Subject Name: Applied Thermodynamics

Date: 13.12.2024 Max Marks: 70

Duration: 03 Hrs Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options are specified in respective section.
(iii) Different parts (if any) in section C carry equal marks
(iv) Steam tables are required.
(v) One dimensional air flow chart is required

Section A

Multi Choice Questions **[1x10=10]**

1. Which of the following cycles may have highest efficiency under ideal conditions?
   (a) Ericsson (b) Stirling (c) Carnot (d) All of the above
2. For a subsonic flow the increase in velocity from inlet to exit may be obtained from a duct of
   (a) Diverging cross-sectional area type
   (b) Converging cross-sectional area type
   (c) Diverging converging cross-sectional area type
   (d) None of these
3. In Dual cycle, heat rejection takes place _____
   (a) at constant volume
   (b) first at constant volume then at constant pressure
   (c) constant pressure
   (d) none of the mentioned
4. Sonic velocity (C) for adiabatic process is given as
   (a) C = $\sqrt{\gamma RT^2}$
   (b) C = γRT^2
   (c) C = $\sqrt{\gamma RT}$
   (d) C = γRT

5. The work input to air compressor is minimum if the compression law followed is
   (a) $PV^{\gamma} = C$ (b) $PV^{1.2} = C$ (c) $PV^{1.35} = C$ (d) $PV = C$

6. Diesel cycle has
   (a) One isobaric, one isochoric and two adiabatic processes
   (b) Two isochoric and two adiabatic processes
   (c) One adiabatic, one isobaric and two isochoric processes
   (d) Two isothermal and two adiabatic processes

7. Re-heater with intercooler in ideal brayton cycle improves efficiency of the cycle. Both the devices ideally work in _____ condition.
   (a) isochoric (b) isentropic (c) isobaric (d) isothermal

8. The amount of steam required to produce one KW net-work output is
   (a) Specific steam consumption.
   (b) Break Power
   (c) Compression ratio
   (d) FAD

9. 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

10. The intermediate pressure of two stage compressor with intercooler is
    (a) $P_2 = 1/P_1P_3$ (b) $P_2 = P_1P_3$ (c) $P_2 = (P_1P_3)^{1/2}$ (d) $P_2 = (P_1P_3)^2$

Section B

All questions are compulsory **[2x5=10]**

11. Explain dalton's law of partial pressure.

12. Draw a well labelled PV & TS graph for Ericsson cycle.

13. Define free air delivery.

14. Explain Henry's law and Henry's constant

15. Write four Maxwell relations.

Section C

Attempt any 05 questions out of 7 **[10x5=50]**

16. What is mean effective pressure? Derive an expression for mean effective pressure of otto cycle.

17. Enlist the main components of SI engine. Explain the working of spark ignition engine with neat sketch.

18. The compression ratio of an air standard diesel cycle is 16. The pressure and temperature just before compression is 0.1 MPa and 15°C, respectively. After isentropic compression, heat is added at constant pressure until temperature reaches 1480°C. Calculate (a) the cut off ratio, (b) the heat supplied per kg of air, (c) the cycle efficiency, and (d) mean effective pressure.

19. Steam at 20 bars, 360°C is expanded in a steam turbine to 0.08 bars. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assuming ideal processes, find per kg of steams of the net work and the cycle efficiency.

20. (a) Explain Joule Thomson coefficient. Sketch an inversion curve and brief description.
(b) Explain Clapeyron equation and derive Clapeyron-Clausius equation from it.

21. A gas mixture consists of 0.4 kg of carbon mono oxide, 1.1 kg of carbon di oxide and 1.5 kg of nitrogen. Find (a) mass fraction of each component, (b) mole fraction of each component, (c) average molar mass of the mixture, (d) gas constant of the mixture.

22. (a) What is choke flow? Explain with the help of curve plotted between mass flow rate and critical pressure ratio.
(b) What is multistage compression in air compressors? Show it with PV plot