INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

End Semester Examination (Dec-2019/Jan-2020)

B. Tech (Marine Engineering)

Semester-II

Applied Thermodynamics-I

(UG11T3203)

Date: 06/01/2020 Maximum marks: 70

Time: 3 Hrs Pass Marks: 35

PART-A (Marks: 10×2 = 20)

(All Questions are compulsory)

1. Write the expressions of efficiency in case of (i) Carnot Cycle (ii) Diesel Cycle.

2. Define compression ratio and indicated power.

3. What is the difference between Ideal and Real gas

4. What is regenerative Rankine Cycle?

5. State Boyle's Law and Charles' Law for a perfect gas.

6. What are the advantages of using a multistage compressor?

7. Why is intercooling necessary in multistage reciprocating compressors?

8. What is a centrifugal compressor? Define briefly.

9. What do you understand by positive displacement type compressors?

10. What is partial pressure and state Dalton's law of partial pressure

PART-B (Marks: 5×10 = 50)

(Answer any 5 of the following 7 Questions)

11. a) Describe the Carnot Cycle and derive the expression of Carnot efficiency. (5)

b) A Carnot engine working between 400°C and 40°C produces 130 kJ of work. Determine:

(i) The engine thermal efficiency.

(ii) The heat added.

(iii) The entropy changes during heat rejection process. (5)

12. A four cylinder four stroke engine gave the following results on a test-bed. Shaft speed = 2500 rev/min, Torque arm = 0.4 m, Net brake load = 200 N, Fuel consumption = 2 g/s, Calorific value =42 MJ/kg, Area of indicator diagram = 300 mm^2, Pressure scale = 80 kPa/mm, Stroke = 100 mm, Bore = 100 mm, Base length of indicator diagram = 60 mm. Calculate Brake Power, Energy supplied by fuel, Indicated Power, Mean effective pressure, Brake thermal efficiency and Indicated thermal efficiency. (10)

13. a) Explain with the help of neat diagram a Regenerative Cycle. Also draw the T-s diagram. (5)

b) Explain the effect of increasing the boiler pressure and decreasing the condenser pressure in Rankine cycle with the help of T-s diagram.(5)

14. a) Show that the specific heat capacities of an ideal gas are related as C_p-C_v= R. (4)

b) 1 kg of air at a pressure of 8 bar and a temperature of 100°C undergoes a reversible polytropic process following the law $pv^{1.2}$ = constant. If the final pressure is 1.8 bar determine:
(i) The final specific volume, temperature and increase in entropy;
(ii) The work done and the heat transfer.
(Take R = 0.287 kJ/kgK and γ = 1.4) (6)

15. a) Why is multistage compression required? Draw P-v diagram for multistage reciprocating air compressor with clearance (4)

b) A single–stage double–acting air compressor is required to deliver 14 m^3 of air per minute measured at 1.013 bar and 150°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:
a) Swept volume of the cylinder
b) The delivery temperature
c) Indicated power. (6)

16. a) Describe the construction and working of centrifugal compressor with neat sketch and pressure velocity variation diagram (8)

b) What is slip and slip factor in centrifugal compressors? (2)

17. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m^3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C respectively. The air is compressed to a final pressure of 0.7 MPa. The intermediate pressure is ideal and intercooling is perfect. The compression index in both the stages is 1.25 and the compressor runs at 600 rpm. Neglecting clearance, determine:
a) the intermediate pressure
b) The power required to drive the compressor
c) The total volume of each cylinder
d) The rate of heat rejection in the intercooler
(Take: c_p = 1.005 kJ/kg°K and R = 0.287 kJ/kg°K) (10)

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