Indian Maritime University

(A Central University, Government of India)

June/July 2019 End Semester Examinations

B.Tech. (Marine Engineering)

Semester- II

Applied Thermodynamics-I (UG11T3203)

Date:29.06.2019 Maximum marks: 100

Time: 3 Hrs Pass Marks: 50

PART-A (Marks: 10×3 = 30)

(All Questions are compulsory)

1. a) Draw P-v and T-s diagram of Dual cycle and name the processes

   b) What is Mean effective pressure and Indicated Power of an IC engine?

   c) What are the advantages on Reheat Rankine cycle?

   d) Why is Carnot cycle not practicable for steam power plant?

   e) What is mole fraction? Write its formula.

   f) State Gibbs-Daltons law of Ideal gas mixture.

   g) What is Isothermal efficiency of a reciprocating compressor?

   h) What are the advantages of multi stage compressor over single stage?

   i) Draw pressure-velocity variation diagram for Centrifugal compressor

   j) What is Pre-whirl and what should be the limiting value of Mach number at the inlet to the centrifugal compressor?

PART-B (Marks: 5×14 = 70)

(Answer any 5 of the following 7 Questions)

2. a) Explain Dual cycle with the help of P-v and T-s diagram (7)

   b) In an engine working on Dual cycle, the pressure and temperature at the beginning of cycle are 1 bar and 90°C respectively. The compression ratio is 9. The maximum pressure is limited to 68 bar and the total heat supplied per kg of air is 1750 kJ. Determine: i) Pressure and Temperature at all points. (Take γ for air=1.4) (7)

3. a) Explain with a neat diagram, the working of four stroke diesel engine. (7)

   b) In a laboratory experiment, the following observations were noted during the test of a four stroke four cylinder Diesel engine. Area of indicator diagram (A_d) = 420 mm^2, Length of indicator diagram (L_d) = 62 mm, Spring constant or scale = 1.1 bar/mm, Diameter of the piston = 100 mm, Length of stroke = 150 mm, Engine speed = 450 rpm. Determine: i) Indicated Mean Effective Pressure ii) Indicated Power (7)

4. a) Explain the effect of operating conditions on Rankine cycle. (7)

   b) Explain Regenerative Rankine cycle with block diagram and T-s diagram (7)

5. a) State and explain Dalton's law and Amagat's law of additive pressures and additive volumes respectively. (7)

   b) A vessel of 1.5 m^3 capacity contains oxygen at 7 bar and 40°C. The vessel is connected to another vessel of 3 m^3 capacity containing carbon monoxide at 1 bar and 15°C. A connecting valve is opened and the gases mix adiabatically. Calculate the final temperature of the mixture. (For oxygen, C_V=21.07 kJ/kmol K; For carbon monoxide, C_v= 20.86 kJ/ kmol K). (7)

6. a) Derive the expression for volumetric efficiency of Reciprocating air compressor with clearance (7)

b) A reciprocating air compressor has cylinder with 24 cm bore and 36 cm stroke. Compressor admits air at 1 bar, 17°C and compresses it up to 6 bar. Compressor runs at 120 rpm. Considering compressor to be single acting and single stage and neglecting clearance, determine mean effective pressure and indicated power required when it compresses following the polytropic process with an index of compression of 1.3 (7)

7. a) Explain multistage compression with the help of block diagram and p-V diagram? (7)

b) A two stage single acting reciprocating air compressor draws 6 kg/min of air at 1.01325 bar and 20°C and the same is delivered at 14.75 bar. Assume perfect intercooling and optimum intermediate pressure with compression index of 1.25. Determine: i) Shaft power required with mechanical efficiency of 85% and ii) Isothermal efficiency. (7)

8. a) Explain the working of centrifugal compressor with the help of Diagram (7)

b) Draw the inlet and outlet velocity triangles of centrifugal compressor and write the meaning of terms involved in it. (7)