

INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

May/June 2018-End Semester Examination

B.Tech(Marine Engineering)

Semester II

Applied Thermodynamics I (UG11T3203)

Date: 14-06-2018

Maximum Marks:100

Time: 3 Hrs

Pass Mark : 50

PART-A

(Marks: 10 x 3=30)

(All Questions are compulsory)

1. a) What are the basic considerations in ideal gas cycles?
- b) Draw P-v and T-s diagram of Dual cycle
- c) Draw the block diagram of Binary vapour cycle
- d) What is Turbine and Pump efficiency with regard to Rankine cycle?
- e) Define molar mass and write its SI unit
- f) What is Gravimetric and Volumetric analysis of a gas mixture?
- g) Define volumetric efficiency of a reciprocating compressor
- h) Draw p-V diagram of two stage reciprocating compressor with clearance and show the effect of intercooling on compression work.
- i) Why pre whirl is required in centrifugal compressor?
- j) What is slip and slip factor?

PART- B

(Marks: 5x14 = 70)

(Answer any 5 of the following 7 Questions)

- 2.a) Explain Diesel cycle with the help of P-v and Γ -S diagram (7)
- b) In a dual combustion cycle the maximum temperature is 2000°C and the maximum pressure is 70 bar. Calculate the temperatures at all cardinal points when the pressure and temperature at the start of compression are 1 bar and 17°C respectively. The compression ratio is 18: 1 and $\gamma = 1.4$ (7)
- 3.a) Derive the expression for the air standard efficiency of Otto cycle. (7)
- b) A four stroke single cylinder diesel engine has a cylinder bore of 150 and a stroke of 250 mm. The crankshaft speed is 300 rpm and fuel consumption is 1.2 kg/h, having a calorific value 39900 kJ/kg. The indicated mean effective pressure is 5.5 bar. If the compression ratio is 15 and cut-off ratio is 1.8, calculate the relative efficiency, taking $\gamma = 1.4$ (7)

4. a) Explain the effect of increasing the boiler pressure and decreasing the condenser pressure in Rankine cycle with the help of T-s diagram. (7)
- b) Explain combined gas-vapour power cycle with block diagram and T-s curve. (7)
5. a) State and explain Dalton's law of partial pressure (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, $C_v = 21.07 \text{ kJ/kmol K}$; For carbon monoxide, $C_v = 20.86 \text{ kJ/kmol K}$). (7)
- 6.a) Derive the expression for the work done in single stage reciprocating compressor without clearance. (7)
- b) A single stage reciprocating compressor takes 1 m^3 of air per minute at 1.013 bar and 15°C and delivers at 7 bar. Assuming the law of compression to be $pV^{1.35} = C$ and negligible clearance; calculate the indicated power. (7)
7. a) Sketch and briefly explain the working principle of Inline Reciprocating Compressor? (7)
- b) In a single acting, two stage reciprocating air compressor 4.5 kg of air per minute is compressed from 1.013 bar and 15°C through pressure ratio of 9 to 1. Both stages have the same pressure ratio, and the law of compression and expansion in both stages is $pV^{1.3} = \text{constant}$. If intercooling is perfectly done, calculate the indicated power and mass induced per cycle if compressor runs at 300 rpm. (7)
8. a) Explain in short the working of centrifugal compressor with the help of pressure velocity variation diagram. (7)
- b) Draw the inlet and outlet velocity triangles of centrifugal compressor and write the meaning of terms involved in it. (7)
