INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

May/ June 2017 End Semester Examinations

B.Tech. (Marine Engineering) Second Semester

(AY 2009-2014 batches)

Applied Thermodynamics – I (UG11T1203/ UG11T2203)

Date : 15.06.2017 Maximum Marks: 100

Time: 3 Hrs Pass Marks : 50

Part – A (10 x 3=30 Marks)

(All questions are compulsory)

1.(a) Explain Carnot's principle.

(b) What are four basic components of a steam power plant?

(c) Compare the Rankine cycle with Carnot cycle in terms of efficiency and work ratio.

(d) Write equation of mean effective pressure.

(e) Explain the term diagram factor as applied to steam engine.

(f) What is free air delivered for compressors? Explain.

(g) What is compressor performance? What are the parameters which affects the compressor performance ?

(h) Explain with neat sketch multistage compression.

(i) State Amagat's law of partial volume and Gibbs Dalton law

(j) Define a) Relative humidity b) Dew point temperature

Part – B (5 x 14=70 Marks)

(Answer any 5 of the following)

2. (a)Establish the general expression for the change in entropy of an ideal gas from the first law of thermodynamics (i) in terms of volume and absolute temperature (ii) in terms of pressure and volume (6 Marks)

2. (b) A rigid cylinder containing 0.004 m^3 of nitrogen at 1 bar and 300 K is heated reversibly until temperature becomes 400 K. Determine : (i) The heat supplied. (ii) The entropy change. Assume nitrogen to be perfect gas having molecular mass = 28 Kg/Kmol and take γ = 1.4 (8 Marks)

3. (a) Explain the effect of operating conditions on Rankine cycle(6 Marks)

(b) In a reheat Rankine cycle steam enters the high pressure turbine at 40 bar and 500° C, and is condensed in the condenser at a pressure of 0.035 bar. Assume that the steam is just dry saturated on leaving the high pressure turbine, and is reheated to its initial temperature before it enters the low pressure turbine. Determine the thermal efficiency of the cycle and the specific steam consumption. (8 Marks)

4. (a) Explain the following efficiencies as applied to steam engines.

(i) mechanical efficiency (ii) thermal efficiency
(iii) relative efficiency (iv) overall efficiency (8 Marks)

(b) A double acting single cylinder steam engine runs at 250 r.p.m. and develops 30 kW. The pressure limits of operation are 10 bar and 1 bar. The cut-off is at 40% of the stroke. The stroke/bore ratio is 1.25 and the diagram factor is 0.75. Assume no clearance and hyperbolic expansion and determine the (i) mean effective pressure (ii) length of stroke (iii) diameter of bore (6 Marks)

5. (a) Derive an expression for roots efficiency for roots blower. (6 Marks)

(b) A single stage single acting reciprocating air compressor intakes 1.4 kg air per min and compresses it to 6 bar according to the law $pV^{1.35}$= constant. The pressure and temperature at intake are 1bar and20° C. Calculate temperature at discharge and the power input to the compressor. (8 Marks)

6. A two stage single acting reciprocating compressor takes in air at the rate of 0.2 m^3/s. The inlet pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a final pressure of 0.7MPa. The intermediate pressure is ideal and the intercooling is perfect. The

compression index in both the stages is 1.25 and compressor runs at 600 rpm.

Determine the following neglecting clearance.(i) the intermediate pressure (ii) total volume of each cylinder (iii) power required to drive the compressor (iv)heat rejected in an intercooler (14 Marks)

7. A mixture consisting of 6 kg of O_2 and 9 kg of N_2 has a pressure of 3 bar and temperature of 20°C. For the mixture determine the following: (i) the mole fraction of each component (ii) the average molecular weight (iii) the specific gas constant (iv) the volume and density (v) the partial pressures and partial volumes. (14 Marks)

8. (a) The atmospheric conditions are 20°C and specific humidity of 0.0095kg/kg of dry air. The barometric pressure of air is 101 kN/m^2 .Calculate the following:

i) partial pressure of vapour

ii) relative humidity

iii) dew point temperature (10 Marks)

(b) Explain about psychrometric chart. (4 Marks)

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