

INDIAN MARITIME UNIVERSITY
(Central University, Government of India)

May/June 2016 End Semester Examinations
B.Tech. (Marine Engineering)

Second Semester – Applied Thermodynamics – I (UG11T2203/UG11T1203)

Date : 13.06.2016

Max Marks: 100

Time: 3 Hrs

Pass Marks: 50

Note: (Non Programmable Scientific calculator , Steam tables , Mollier Chart are allowed)

Part-A

(3 x 10 = 30 Marks)

Compulsory Question

- 1)
- a) State different statements of second law of thermodynamics.
 - b) Define entropy and irreversibility.
 - c) Draw the T-S diagram and P-V diagram for simple Rankine cycle with superheated steam.
 - d) Give reasons for compounding steam engines.
 - e) What is meant by Mean Effective pressure Of steam Engines.
 - f) What are the advantages of centrifugal air compressors?
 - g) What are advantages of multi stage air compressor over single stage compressor.
 - h) What are the uses of compressed air?
 - i) State Gibbs Daltons law for gas Mixtures.
 - j) Define the terms (i) Relative Humidity (ii) Specific Humidity (iii) Dew point temperature.

Part-B

(14 x 5 =70 Marks)

Answer any Five Questions

2. (a) Establish a General Expression for Change in entropy of an Ideal gas in terms of Volume and Absolute Temperature
- (b) 2.0 kg of air is heated from 27degC to 427degC while the pressure changes from 100 kPa to 600 kPa. Calculate the change in entropy.
($R = 0.257 \text{ kJ / kg K}$, $C_p = 1.005 \text{ kJ / kg K}$) (7+7)
3. (a) What is (i)Heat engine (ii) Heat pump (iii) Refrigerator
- (b) A Carnot cycle operates between source and sink temperatures of 250°C and -15°C. If the system receives 90 kJ from the source, find (i) Efficiency of the system ;
(ii) The net work transfer ;(iii) Heat rejected to sink. (6+8)
4. (a) What are the various methods to improve efficiency of Rankine cycle.
- (b) A Rankine cycle works between 40 bar, 400DegC (at the boiler exit) and 0.035 bar at the condenser. Calculate the Rankine efficiency. Assume isentropic expansion.
Neglect the feed pump work. (7+7)

5. (a) Explain the term ' *diagram factor* 'as applied to steam engines?
- (b) A single-cylinder, double-acting steam engine of 20 cm diameter and 40 cm stroke is supplied with steam at 834 kPa and exhausts at 14.7 kPa. Cut-off takes place at one third stroke and the engine runs at 120 RPM. diagram factor is 0.7, Calculate the actual mean effective pressure and the indicated power of the engine. (4+10)
6. (a) Derive an expression for work required for single stage reciprocating air compressor neglecting clearance volume.
- (b) A double-acting, single cylinder air compressor runs at 100 r.p.m. The air is compressed from an initial pressure of 100 kPa (1 bar) to a delivery pressure of 750 kPa (7.5 bar). The stroke volume is 0.15 m^3 and law of compression and expansion is $pv^{1.25} = C$. If the clearance volume is 1/18th of the stroke volume. Calculate: (a) Volumetric efficiency (b) the volume of air taken in per stroke, and (c) the indicated power of the compressor. (5+9)
7. A vessel of 1.8 m^3 capacity contains oxygen at 8 bar and 50°C . The vessel is connected to another vessel of 3.6 m^3 capacity containing carbon monoxide at 1 bar and 20°C . A connecting valve is opened and the gases mix adiabatically. Calculate (i) The final temperature and (ii) pressure of the mixture (Take : For oxygen $C_v = 21.07 \text{ kJ/mole K}$. For carbon monoxide $C_v = 20.86 \text{ kJ/mole K}$ Universal gas constant, $R=8314\text{J/kg K}$). (14)
8. (a) Describe a Psychometric Chart.
- (b) Atmospheric air at 1.01325 bar has 30°C Dry bulb temperature and 15°C Dew point temperature. Calculate:
1. Partial pressures of air and water vapour
 2. Specific humidity
 3. Relative humidity
- (8+6)
