INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)

May/ June 2017 End Semester Examinations
B.Tech. (Marine Engineering) Third Semester
(AY 2009-2014 batches)

Applied Thermodynamics-II (UG11T1303/ UG11T2303)

Date : 01.07.2017 Maximum Marks: 100
Time: 3 Hrs Pass Marks : 50

PART – A Marks:10X3=30

(All questions are compulsory)

1. (a) Explain Fourier's law of heat conduction.

   (b) Define free convection and forced convection.

   (c) Define one tonne of refrigeration.

   (d) Name four important properties of a good refrigerant.

   (e) Define (i) actual COP (ii) theoretical COP (iii) relative COP

   (f) What is stoichiometric air-fuel ratio and excess air?

   (g) Define higher and lower calorific value.

   (h) What is the difference between nozzle and diffuser?

   (i) What is Mach number and its value for subsonic, sonic and supersonic flow?

   (j) Define the term "carry over loss" as applied to simple impulse turbine.

PART – B Marks:5X14=70

(Answer any 5 of the following)

2. Coal from Jharkhand which has an ultimate analysis (by mass) as 84.36 percent C, 1.89 percent H_2, 4.40 percent O_2, 0.63 percent N_2, 0.89 percent S, and 7.83 ash (non-combustibles) is burned with theoretical

amount of air. Disregarding the ash content, determine the mole fraction of the products and the apparent molar mass of the product gases. Also determine the air-fuel ratio required for this combustion.

(14 Marks)

3.(a) What are the factors affecting the performance of a vapour compression system? Explain any four.

(8 Marks)

3. (b) A refrigeration system operates on the reversed Carnot cycle. The higher temperature of the refrigerant in the system is 35° C and the lower temperature is -15° C. The capacity is to be 12 tonnes. Neglecting all losses, determine (i) C.O.P. (ii) heat rejected from the system per hour (iii) power required

(6 Marks)

4. (a) Dry saturated steam at 10 bar is expanded isentropically in a nozzle to 0.1 bar. Using steam tables only find the dryness fraction of the steam at the exit. Also find the velocity of the steam leaving the nozzle when (i) initial velocity is negligible (ii) initial velocity of steam is 135 m/s.

(10 Marks)

4. (b) What is nozzle efficiency? Discuss the effect of friction on the flow through steam nozzle. (4 Marks)

5. A velocity compounded impulse turbine has two rows of moving blades with a fixed row of guide blades. The steam leaves the nozzle at 900 m/s in a direction at 18° to the plane of rotation. The blade speed is 150 m/s and the blade outlet angles are 24°, 26°, and 30° for the first moving, first fixed and second moving respectively. The friction factor is 0.9 for all rows. The steam supply is 4500 kg/hour. Draw the velocity diagram to suitable scale and determine (i) tangential force on the rotor (ii) total work done on the blades (iii) power developed by the turbine.

(14 Marks)

6. (a) Explain the physical significance of Reynold's number, Nusselt number, Grashof number and Prandtl number.

(8 Marks)

6.(b) Describe simple vapour compression cycle with flow diagram.

(6 Marks)

7. In a counter flow double pipe heat exchanger, water is heated from 25° C to 65° C by an oil with a specific heat of 1.45 kJ/kg.K and mass flow rate of 0.9 kg/s. The oil is cooled from 230° C to 160° C. If the overall heat transfer coefficient is 420 W/m^2 ° C, calculate the following (i) the rate of heat transfer (ii) the mass flow rate of water (iii) the surface area of the heat exchanger

(14Marks)

8. (a) Define thermal conductivity and thermal resistance.

(4 Marks)

8. (b) A mild steel tank of wall thickness 12 mm contains water at 95° C. The thermal conductivity of mild steel is 50 W/m ° C, and the heat transfer coefficients for the inside and outside of the tank are 2850 and 10 W/m^2 ° C, respectively. If the atmospheric temperature is 15° C , calculate (i) the rate of heat loss per m^2 of the tank surface area (ii) the temperature of the outside surface of the tank

(10 Marks)