INDIAN MARITIME UNIVERSITY
(Central University, Government of India)

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

Third Semester – Applied Thermodynamics- II (UG11 T1303/ T2303)

Date : 25.06.2016 **Max. Marks: 100**
Time: 3 Hrs **Pass Marks : 50**

Part – A **(3 x 10 = 30 Marks)**
Compulsory Question

1) a) Define the terms: Air-fuel ratio, excess air and dissociation.

b) Explain Mach number.

c) Define the following:

(i) Actual COP (ii) Theoretical COP (iii) Relative COP

d) Explain natural and forced convection.

e) What is diagram efficiency for steam turbine?

f) Explain Fourier's law of heat conduction.

g) Distinguish between coolers and condensers

h) Define 'one Tonne of Refrigeration'. Find its value in kJ/hr.

i) Define (i) blade efficiency and (ii) stage efficiency.

j) What is Grashof number.

Part – B **(5x14 = 70 Marks)**
Answer any five of the following.

2. Methane (CH_4) is burned with atmospheric air. The analysis of the products on a dry basis is as follows:

$CO_2 = 10\%$, $O_2 = 2.37\%$, $CO = 0.53\%$, $N_2 = 87\%$

(i) Determine the combustion equation.

(ii) Calculate the air-fuel ratio.

(iii) Percent theoretical air. (14 Marks)

3. a) Explain the physical significance of Reynold's number, Stanton number, Grashof number and Nusselt Number. (8 Marks)

b) Water enters the tubes of a small single pass heat exchanger at 20°C and leaves at 40°C. On the shell site, 25 Kg/min of steam condenses at 60°C. Calculate the overall heat transfer co-efficient and the required flow rate of water, if the area of the exchanger is $12m^2$ (The latent heat, $h_{fg} = 2358.7$ kJ/kg at 60°C). Take specific heat of water as 4174 J/kg-K. (6 Marks)

4. a) Explain the difference between an impulse turbine and a reaction turbine. (3 Marks)

b) Derive an expression for maximum blade efficiency in a single-stage impulse turbine. (5 Marks)

c) In a single-stage impulse turbine, the steam flows at a rate of 5kg/s. It has a rotor of 1.2m diameter running at 3000rpm. Nozzle angle is 18°, blade speed ratio is 0.4, velocity coefficient is 0.9, and outlet angle of the blade is 3° less than inlet angle. Determine the blade angle and power developed. (6 Marks)

5. a) Explain the supersaturation phenomenon of steam which expands in a nozzle. (4 Marks)

b) In a steam nozzle, the steam expands from 4bar to 1bar. The initial velocity is 60m/s and initial temperature is 200°C. Determine exit velocity of steam if the nozzle efficiency is 92%. Plot the expansion process in h-s plane. (10 Marks)

6. a) Find an expression for 1-D heat transfer through wall of a hollow cylinder. The inner surface temperature and inner radius of the cylinder are T_i and r_i, respectively. The outer surface temperature and outer radius of the cylinder are T_o ($<T_i$) and r_o, respectively. (8 Marks)

b) The wall of a cold room is composed of 3 layers: the outer is brick of 20cm thick, the middle is cork of 10cm thick and the inside layer is cement of 5cm thick. The temperature of the outer air is 25°C and that of the inside air is -20°C. The film/heat transfer coefficient of the outer air at the brick surface is 45.4 W/m^2-K and that of the inside air is 17 W/m^2-K. Find the heat flow rate through the composite wall. Given k for brick = 3.45 W/m-K, k for cork = 0.043 W/m-K and k for cement = 0.294 W/m-K (6 Marks)

7. a) Plot variation of temperature for (i) parallel- and (ii) cross-flow heat exchangers along their length.

b) Find an expression for LMTD in case of parallel flow heat exchanger (4+10 Marks)

8. a) Describe an ideal vapour compression refrigeration cycle with flow diagram. Plot the cycle on T-s and P-h planes. (8 Marks)

b) The capacity of a refrigerator is 30kW when working between -8°C and 40°C. The actual COP of the refrigerator plant used is one-fourth of the COP of an ideal plant working between the same temperatures. Find the power required to drive the actual plant. (6 Marks)

*****