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

B.Tech. (Marine Engineering)- Semester – III
December 2015 End Semester Examinations

Applied Thermodynamics - II
Subject Code: UG11T2303/ UG11T1303

Time: 3 Hours | Max Marks: 100
Date: 15.12.2015 | Pass Marks: 50

Part-A **(3 x 10 = 30 Marks)**

Compulsory Questions

1. a) Define the term " carry over loss" as applied to simple impulse turbine.

b) Define stoichiometric air fuel ratio, excess air and dissociation.

c) Explain the effect of decrease of condenser pressure and increase of evaporator pressure in vapour compression refrigeration cycle.

d) In a reaction turbine there is a continuous pressure drop and ultimately increase of velocity. True/False? Comments.

e) Write any three combustion equations and explain.

f) Explain the effect of sub cooling of a liquid and superheating of a vapour in a vapour compression refrigeration cycle.

g) What are the difference between a nozzle and a diffuser?

h) Under what conditions a convergent- divergent duct in a nozzle and also a diffuser.

i) Define Fourier law of heat conduction.

j) What do you mean by thermal conductivity of insulating materials?

Part-B **(5 x 14 = 70 Marks)**

Answer any five of the following

2. A sample of dry anthracite has the following composition by mass. (14)

C- 90%; H- 3%; O- 2.5%; N- 1%; S- 0.5%; Ash- 3%. Calculate

i) Stoichiometric A/F ratio.
ii) The A/F ratio and the dry and wet analysis of the product of combustion by mass and by volume when 20% excess air is supplied.

3. i) With a neat sketch define vapour compression refrigeration cycle and what is its COP? (4)

ii) What is one Tonne Refrigeration? (3)

iii) A refrigerator has working temperatures in the evaporator and condenser coils of –30 and 32°C respectively. What is the maximum COP possible? If the actual refrigerator has a COP of 0.75 of the maximum calculate the required power input for a refrigeration effect of 5 KW. (7)

4. i) Derive an expression for overall heat transfer co-efficient considering fluid to fluid heat transfer across a metal boundary. (6)

ii) A Mild Steel tank of wall thickness 10mm contains water at 90°C when the atmospheric temperature is 15°C. The thermal conductivity of mild steel is 50W/mK, and the heat transfer co-efficient for inside and outside of the tank are 2800 and 11W/m²K respectively. Calculate

a) The rate of heat loss per unit area of surface
b) The temperature of the outside surface of the tank (8)

5. The following data relate to a stage of reaction turbine:

Mean rotor dia = 1.5m, speed ratio = 0.72, bled outlet angle = 20°, rotor speed = 3000rpm

i) Determine the diagram efficiency
ii) Determine the percentage increase in diagram efficiency and rotor speed if the rotor is design to run at the best theoretical speed, the exit angle being 20° and absolute velocity at inlet is 327.2 m/sec. (14)

6. An ammonia refrigerating machine fitted with an expansion valve works between the temperature limit of −10°C and 30°C. The vapour is 95% dry at the end of isentropic compression and the fluid leaving the condenser is at 30°C. Assuming actual COP at 60% of the theoretical, Calculate Kilograms of ice produced per KW- hr at 0°C from water at 10°C. Latent heat of ice is 335KJ/kg. Ammonia has the following properties: (14)

Temp. °C	Liquid heat (hf KJ/kg)	Latent heat (hfg KJ/kg)	Liquid Entropy (st)	Total Entropy of dry saturated vapour
30	323.08	1145.80	1.2037	4.9842
−10	135.37	1297.68	0.5443	5.4770

7.i) Dry saturated steam at a pressure of 11 bar enters a convergent divergent nozzle and leaves at a pressure of 2 bar. If the flow is adiabatic and frictionless, determine:

a) The exit velocities of steam.

b) Ratio of cross section at exit and at throat. Assume the index of adiabatic expansion to be 1.135. (7)

ii) The nozzles of a delaval steam turbine are supplied with dry saturated steam at a pressure of 9 bar. The pressure at the outlet is 1 bar. The turbine has two nozzles with a throat diameter of 2.5 mm. Assuming nozzle efficiency has 90% and that of turbine rotor 35% find the quality of steam used per hour and the power developed. (7)

8. Explain forced convection of heat transfer and arrive at the expression for Nusselt, Prandtl and Reynolds number. (14)

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