INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

End Semester Examinations, December 2017.
B. Tech. (Marine Engineering) Third Semester

Applied Thermodynamics-II (UG11T2303)/UG11T1303

Date: 09.12.2017 Maximum Marks: 100
Time: 3 hours Pass Marks :50

PART – A (3 x 10 = 30)

(Answer all Questions.)

1. a) Define the unit one '*ton*' of refrigeration and what is its value in kJ/min?
   b) What is Pressure and Velocity compounding in steam turbine?
   c) What is Actual and Stoichiometric air-fuel ratio?
   d) Explain the effects of sub-cooling and super heating on Vapour Compression Cycle?
   e) Explain stagnation state of an isentropic flow?
   f) What is Mach number? Prove that c = $\sqrt{(\gamma RT)}$, where the notations have their usual meaning.
   g) Explain Nusselt number, Prandtl number and Reynolds number.
   h) What is natural and forced convection?
   i) Write three combustion equations and explain.
   j) What is the difference between nozzle and diffuser. Explain with sketches.

PART - B (14 x 5 = 70)

(Answer any five Questions.)

2. A sample of dry anthracite has the following composition by mass:-
   C – 90%, H – 3%, O – 2.5%, N – 1%, S – 0.5%, Ash – 3%, Calculate:
   i) The Stoichiometric Air-Fuel ratio.
   ii) The Air-Fuel ratio and the dry and wet analysis of the product of combustion by mass and by volume, when 20% excess air is supplied. (14)

3. a) Derive an expression for overall heat transfer coefficient for transfer of heat from one fluid to another through a plane wall.
   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 coefficient for the inside and outside of the tank are 2850 and 10 W/m² °C respectively. If the atmospheric temperature is 15°C, Calculate:
   i) The rate of heat loss/ m² of the tank surface area.
   ii) The temperature at the outside of the tank. (6+8)

4. a) The capacity of Refrigeration plant is 200 TR, when working between -6°C and 25°C. Determine the mass of ice produced per day from water at

25°C. Also calculate the power required to drive the unit. Assume that the cycle operates on Reversed Carnot Cycle and the latent heat of ice is 335 kJ/kg.

b) A Vapour Compression Cycle refrigerator uses methyl Chloride (R-40) as refrigerant and operates between temperature limits of – 10°C and 45°C. At entry to the compressor the refrigerant is dry saturated and after compression it acquires a temperature of 60°C. Find the COP of the refrigerator. The relevant properties of the refrigerant R-40 is given below:-

Saturation Temperature	Enthalpy (kJ/kg)		Entropy (kJ/kg K)	
	Liquid	Vapour	Liquid	Vapour
-10°C	45.4	460.7	0.183	1.163
45°C	133.0	483.6	0.485	1.587

(7+7)

5. 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:
   i) The exit velocity of steam and
   ii) Ratio of cross section areas at exit and throat. Assume $\gamma = 1.135$ (14)

6. a) What are the differences between Impulse and reaction Turbine?
   b) In an Impulse Turbine (with a single row wheel) the mean diameter of the blade is 1.05 m and the peed is 3000 rpm. The nozzle angle is 18°, the ratio of the blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blade to that at inlet is 0.84. The outlet angle of the blade is to be made 3° less than the inlet angle. The steam flow is 10 kg/s. Draw the velocity diagram for the blades and determine the following:
   i) Tangential thrust on the blade.
   ii) Axial thrust on the blade.
   iii) Resultant thrust on the blade.
   iv) Power developed on the blade and
   v) Blading efficiency. (4+10)

7. a) Show that the condition for maximum efficiency of blade in Impulse turbine is $\cos^2\alpha$, where α is the nozzle angle.

   b) The following data refer to a particular stage of Parsons reaction Turbine:- Speed of the Turbine = 1500 rpm, Mean diameter of the rotor = 1 m, Stage efficiency = 80%, Blade outlet angle = 20°, Speed ratio = 0.7. Determine available enthalpy drop in a stage. (7+7)

8. Prove that Nusselt number is a function of Reynolds number and Prandtl number. (14)

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