

INDIAN MARITIME UNIVERSITY
(A CENTRAL UNIVERSITY, GOVERNMENT OF INDIA)
B.TECH (MARINE ENGINEERING)
DECEMBER2014/JANUARY END SEMSTER EXAMINATION
III SEMESTER

APPLIED THERMODYNAMICS - II (T 2303 / T 1303)

Time: 03.00 Hrs
Date:27-12-2014

Max. Marks: 100
Pass Marks: 50

PART- A (3 × 10 = 30 Marks)

Compulsory Questions

1.
 - a) Define Calorific value of fuel.
 - b) What is compounding of Steam turbine?.Draw pressure – velocity compounding.
 - c) Define conduction, convection and radiation.
 - d) Define “one Tonne of Refrigeration”.
 - e) Define thermal conductivity. Derive the unit thermal conductivity.
 - f) In an impulse turbine the pressure drop takes place in the nozzle only.True/false?. Comment.
 - g) Define nozzle.Enumerate types of nozzles.
 - h) Define Heat Exchanger. Draw direct transfer type heat exchanger.
 - i) Write any three Combustion equations
 - j) Draw parallel flow and counter flow heat exchangers.

PART-B (5 × 14 = 70 Mark)

Answer any five of the following

2. a) A gas consists of 14.2% CH₄, 5.9% CO₂, 36% CO, 40.5%H₂, 0.5%O₂, 2.9%N₂. Determine the stoichiometric volume of air for the complete combustion of 1m³ of this gas and also the products of combustion both in m³/m³ of gas and as a percentage. [10 marks]
- b) Define Fuel, complete combustion, incomplete combustion, Stoichiometric Air fuel ratio [4 marks]

3/ Steam enters a group of convergent-divergent nozzles at a pressure of 2.2 MN/m^2 and with a temp. of 260°C . equilibrium expansion through the nozzles is to an exit pressure of 0.4 MN/m^2 . Up to the throat of the nozzles the flow can be considered as frictionless. But from throat to exit there is an efficiency of expansion of 85%. The rate of steam flow through the nozzles, is 11 kg/s . using the enthalpy-entropy chart for steam, determine:

- a) the throat and exit velocity
- b) the throat and exit area. [14 marks]

4. Two rows of a velocity compounded impulse turbine have a mean blade speed of 150 m/s and with nozzle velocity of 675 m/s and nozzle angle of 20° . The exit angles of the first moving row, the fixed row and the second row of moving blades are 25° , 25° , 30° , respectively. There is a 10% loss of velocity due to friction in all blades. The mass flow rate is 4.5 kg/s . Draw the velocity diagram to suitable scale and determine:

- a) the power output of the turbine
- b) the diagram efficiency [14 marks]

4. a) Draw and explain the reversed carnot cycle with p-v and T-s diagrams. [6 marks]

b) A refrigerator has working temperatures in the evaporator and condenser coils of -30 and 32° 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 refrigerating effect of 5 kW . [8 marks]

5. Explain three types of compounding done in steam turbine. Define fixed blade, moving blade and nozzle. Also draw the pressure velocity variations of all the three types of compounding. [14 marks]

6. a) The inner surface of a plane brick wall is at 40°C and the outer surface is at 20°C . calculate the rate of heat transfer per unit area of wall surface; the wall is 250 mm thick and the thermal conductivity of the brick is 0.52 W/mk . [6 marks]

b) Derive a relation for heat transfer through a hollow sphere. [4 marks]

c) Define Fourier's law of conduction. Explain the relevance of negative sign in it. [4 marks]

8. a) Derive the expression for heat fluid to fluid through wall. [6 marks]

b) A mild steel tank of wall thickness 10 mm contains water at 90°C when the atmosphere temperature is 15°C . The thermal conductivity of mild steel is 50 W/mK , and the heat transfer coefficients for the inside and outside of the tank are 2800 and $11 \text{ W/m}^2\text{k}$ respectively. Calculate:

- i) The rate of heat loss per unit area of tank surface;
- ii) The temperature of the outside surface of the tank. [8 marks]