

Indian Maritime University
(A Central University, Government of India)
June/July 2019 End Semester Examinations
B.Tech. (Marine Engineering)
Semester- III
Applied Thermodynamics-II (UG11T3303)

Date: 13.07.2019
Time: 3 Hrs

Maximum marks: 100
Pass Marks: 50

Part A

10x3 = 30 Marks

(All questions are compulsory)

1. (a) Define thermal conductivity and thermal resistance.
- (b) What is the difference between nozzle and diffuser?
- (c) What is stoichiometric air-fuel ratio and excess air?
- (d) Plot variation of temperature for (i) parallel- and (ii) cross-flow heat exchangers along their length
- (e) What is thermal boundary layer thickness?
- (f) Define Absorptivity, reflectivity and transmissivity.
- (g) What is Mach number and its value for subsonic, sonic and supersonic flow?
- (h) Explain Stefan-Boltzman law.
- (i) Define Overall heat transfer coefficient and write equation for it.
- (j) What is the difference between parallel flow, counter flow and cross flow heat exchanger?

PART – B Marks:

5X14=70 Marks

(Answer any 5 of the following)

2. sample of coal has the following composition by mass

C – 84.36%, H₂ – 1.89%, O₂ – 4.40%, N₂ – 0.63%, Ash – 7.83%.

Calculate,

- i) Mole fraction of the products and apparent molar mass of the product gases,
- ii) A/F ratio required for the combustion process.

(14arks)

3. (a) What is nozzle efficiency? Discuss the effect of friction on the flow through steam nozzle.

(6 Marks)

(k) 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 as 90 % find the quality of the steam used per hour, area at the exit.

(8 Marks)

4. (a) What is Insulation? Explain the factors affecting efficiency of insulators.

(6 Marks)

(b) Calculate the throat and exit areas of a nozzle to expand air at the rate of 4.5 kg/sec from 8.3 bar, 327 °C into a space at 1.38 bar. Neglect the inlet velocity and assume isentropic flow.

(8 Marks)

5. (a) Derive the expression for heat conduction through composite wall?

(6 Marks)

(b) The interior of a refrigerator having inside dimensions of 0.5 m × 0.5 m base area and 1 m height, is to be maintained at 6°C. The walls of the refrigerator are constructed of two mild steel sheets 3 mm thick ($k = 46.5 \text{ W/m}^\circ\text{C}$) with 50 mm of glass wool insulation ($k = 0.046 \text{ W/m}^\circ\text{C}$) between them. If the average heat transfer coefficients at the inner and outer surfaces are $11.6 \text{ W/m}^2^\circ\text{C}$ and $14.5 \text{ W/m}^2^\circ\text{C}$ respectively, calculate:

(i) The rate at which heat must be removed from the interior to maintain the specified temperature in the kitchen at 25°C, and

(ii) The temperature on the outer surface of the metal sheet

(8 Marks)

6. (a) Hot air at a temperature of 65°C is flowing through a steel pipe of 120mm diameter. The pipe is covered with two layers of different insulating materials of thickness 60 mm and 40 mm, and their corresponding thermal conductivities are 0.24 and 0.4 $\text{W/m}^\circ\text{C}$. The inside and outside heat transfer coefficients are 60 and 12 $\text{W/m}^\circ\text{C}$. The atmosphere is at 20°C. Find the rate of heat loss from 60 m length of pipe.

(8 Marks)

(b) Define with significance, Nusselt number, prandtl number & Grasshof's number?

(6 Marks)

7. (a) Water flows inside a tube 45 mm in diameter and 3.2 m long at a velocity of 0.78 m/s. Determine the heat transfer co-efficient and the rate of heat transfer if the mean water temperature is 50°C and the wall is isothermal

at 70°C. For water at 50°C take $k = 0.66 \text{ W/mK}$, $\nu = 0.478 \times 10^{-6} \text{ m}^2/\text{s}$ and Prandtl number = 2.98.

(8 Marks)

(b) Explain the concept of black body radiation with neat sketch.

(6 Marks)

8. (a) Find an expression for LMTD in case of parallel flow heat exchanger.

(6 Marks)

(b) Water flows at the rate of 65 kg/min through a double pipe counter flow heat exchanger. Water is heated from 50°C to 75°C by an oil flowing through the tube. The specific heat of the oil is 1.780 kJ/kg.K. The oil enters at 115°C and leaves at 70°C. The overall heat transfer co-efficient is 340 W/m²K. Calculate the following

i. Heat exchanger area

ii. Rate of heat transfer

(8 Marks)