INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

B. Tech (Marine Engineering)

Semester-III

Dec-2019/Jan-2020 End Semester Examination

Applied Thermodynamics-II

(UG11T3303)

Date: 14/12/2019 Maximum marks: 70

Time: 3 Hrs Pass Marks: 35

Note: Use of steam table and Mollier chart is allowed

PART-A (Marks: 10×2 = 20)

(All Questions are compulsory)

1. What is percentage excess air? Why is it supplied?

2. Write any three combustion equations

3. What is nozzle efficiency?

4. What are the effects on friction on flow through nozzle?

5. State and explain Fourier's law of heat conduction

6. Write an expression for thermal resistance of a composite cylinder

7. Define Reynolds number and Nusselt number

8. Define absorptivity and reflectivity

9. Draw the neat and labeled temperature variation diagram for parallel flow and counter flow heat exchanger

10. What is LMTD? Write its formula

PART-B (Marks: 5×10 = 50)

(Answer any 5 of the following 7 Questions)

11. The gravimetric analysis of hydrocarbon gives: 86% carbon, 14% Hydrogen.Determine the percentage analysis of combustion products by mass and by volume when 50% excess air is supplied for the combustion. (10)

12. a) Explain choked nozzle and stagnation properties in short. (4)

b) Air is expanded reversibly and adiabatically in a nozzle from 13 bar and 150°C to a pressure of 6 bar. The inlet velocity of the nozzle is very small and the process occurs under steady flow conditions. Calculate the exit velocity of the nozzle. (γ for air=1.4) (6)

13. A convergent-divergent nozzle is to be designed in which steam initially at 14 bar and 275°C is to be expanded down to a back pressure of 1.05 bar. Assuming 12% of the total isentropic enthalpy drop to be effective in the divergent part of the nozzle. Determine the necessary throat and exit diameters of the nozzle for a steam discharge of 500 kg/hr. (n=1.3) (10)

14. a) Derive the expression for heat transfer through composite cylinder.(6)

b) A cold room has one of the walls 5 m × 2.5 m made of bricks 12 cm thick insulated externally by cork slab 8 cm thick. Cork is protected externally by 2.5 cm wood. Estimate the heat loss through the wall in 24 hours, if the interior of the cold room is maintained at a temperature of 0°C and the outside temperature is 20°C. Thermal conductivities for brick, cork and wood are 0.93, 0.044 and 0.175 W/m°K respectively. (4)

15. a) A thick walled tube of stainless steel with 20 mm inner diameter and 40 mm outer diameter (K_{steel}=40 W/m°C) is covered with a 30 mm layer of asbestos insulation ($K_{asbestos}$=0.2 W/m°C). If the inside wall temperature of the pipe is maintained at 600°C and outside insulation at 1000°C. Calculate heat loss per meter length of tube (6)

b) Write Newton's law of cooling and Explain forced and natural convection with examples of each? (4)

16. 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 coefficient and rate of heat transfer if the mean water temperature is 50°C and wall is isothermal at 70°C. For water at 50°C take k=0.66 W/m°K, kinematic viscosity = 0.478×10^{-6} m^2/s and Prandtl number = 2.98. Take Nu=0.023(Re) 0.8(Pr) 0.4 (6)

b) Explain

i) Black body
ii) Total emissive power and
iii)Emissivity (4)

17. a) How the heat exchangers are classified? (4)

b) A counter flow heat exchanger cools 1400 kg/hr of oil having heat capacity of 3 kJ/kg°K from 100°C to 30°C by water initially at 20°C. The quantity of water fed is 1300 kg/hr. Calculate water outlet temperature and heat transfer area for overall heat transfer co-efficient of 4000 kJ/hr-m^2. (Take specific heat of water as 4.18 kJ/kgK) (6)

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