INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

End Semester Examination Dec 2019/Jan 2020

B.Tech (Marine Engineering)

Semester- III

Applied Thermodynamics-II

(UG11T1303/2303)

Date: 14.12.2020 **Max Marks: 70**

Time: 3 Hours **Pass Marks: 35**

Part – A (compulsory)

Answer the following (10x2=20 Marks)

1] How variation of heat capacity affects heat transfer ?

2] Define adiabatic flame temperature.

3] What is physical significance of Prandtl number ?

4] Draw thermal boundary formed during flow of cool fluid over a warm Plate.

5] What is fouling in heat exchanger ?

6] What are the important parameters for speed of sound ?

7] What is stagnation point ?

8] Why counter flow heat exchangers are mostly preferred ?

9] Define Opaque body

10] What is critical thickness of insulation ?

Part – B

Answer any 5 out of 7 questions (5 x 10= 50 marks)

11] A square plate heater 15 cm X 15 cm is inserted between two slabs.Slab A is 2 cm thick (K= 50 W/m ^{0}C) and slab B is 1 cm thick (K=0.2 W/m ^{0}C).The outside heat transfer coefficients on side A and side B are 200 W/m^2 ^{0}C and 50 W/m^2 ^{0}C respectively.The temperature of surrounding air is 25 ^{0}C.If rating of heater is 1 KW Find a] Maximum temp. in the system,b] Outer surface temperature of two slabs.

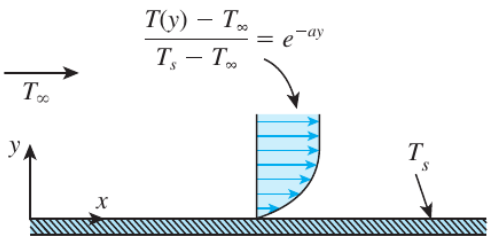
[10 Marks]

12] a)Define what is a Thermal Boundary Layer [3 Marks]

b)During the flow of air at T_∞ = 20° C over a plate surface maintained at a constant temperature of T_s = 160° C, the dimensionless temperature profile within the air layer over the plate is determined to be

$$\frac{T(y)-T\infty}{Ts-T\infty}=e^{-ay}$$

where a = 3200 m^{-1} and y is the vertical distance measured from the plate surface in m (see Fig.). Determine the heat flux on the plate surface and the convection heat transfer coefficient. [7 Marks]



Assume k = 0.03024 W/m·K at a temperature of 90° C.

13] A heat exchanger is to be design to condense an organic vapour at a rate of 500 Kg/min which is available at its saturation temp. 355 K.Cooling water at 286 K is available at a flow rate of 60 Kg/s. The overall heat transfer coefficient is 475 $W/m^2\ ^0C$,Latent heat of condensation of the organic vapour is 600 KJ/Kg,Calculate a] The number of tubes required if 25 mm outer diameter 2 mm thick and 4.87 m long tubes are available and b] The number of tube passes, if the cooling water velocity should not exceed 2 m/s . [10 Marks]

14] A steam pipe of outer diameter 120 mm is covered with two layers of lagging inside layer 45 mm thick (K=0.08 W/m ^0C) and outside layer 30 mm thick (K=0.12 W/m ^0C).The pipe conveys steam at a pressure of 20 bar with 50 ^0C super-heat. The outside temperature of lagging is 25 ^0C,If the steam pipe is 30 m long determine a] Heat lost per hour,b] Interface temp. of lagging,(Assume at **20 bar t_{sat}=212.4 ^0C** Saturation temp.) [10 Marks]

15] Coal from Singapore which has an ultimate analysis by mass as 84.36 % C, 1.89 % H_2 ,4.40 % O_2,0.63 % N_2,0.89 % S and 7.83 % ash non combustible is burned with theoretical air,Disregarding ash content Determine mole fraction of the products and the apparent molar mass of the product gases. Find also air fuel ratio. [10 Marks]

16] a] Explain effect of dissociation on IC engine [5 Marks]

b] Air enters the diffuser with velocity of 200 m/s, Determine the speed of sound and Mach number at the diffuser inlet when the air temperature is 30 ^0C. [5 Marks]

17] Carbon dioxide flows steadily through a varying cross sectional area duct at a mass flowrate of 3 Kg/s.The carbon dioxide enters the duct at a pressure of 1400 KPa and 200 ^0C with a low velocity and it expands in the nozzle to a pressure of 200 KPa.The duct is designed so that the flow can be approximated is isentropic. Determine the density,velocity,flow area and Mach number at a location where a pressure drop 200 KPa along the duct from inlet Assume following data **C_p=0.846 KJ/Kg,K=1.289,R=0.1889 KJ/Kg** [10 Marks]

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