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FACULTY OF ENGINEERING & TECHNOLOGY

M.E(Mechanical) Year Examination - June– 2015

EL-II Advanced Heat Transfer

(Revised)

[Time: Three *Hours*] **[Max. Marks:80]**

"Please check whether you have got the right question paper."

N.B
i) Solve <u>any three</u> questions from each section.
ii) Use of non-programmable calculator is permitted.
iii) Use of Heat Transfer data book and steam tables are permitted.
iv) Assume suitable data, if necessary.

SECTION-A

Q.1 a) Explain basic laws of conduction, convection and radiation. 07

b) A cold storage room has walls made of 220mm of brick on the outside, 90mm of plastic foam and finally 16mm of wood on the inside. The outside and inside air temperatures are 25℃and -3℃ resp. If the inside and outside heat transfers coefficients are respectively 30and 11w/m ℃ .and thermal conductivities of brick, foam wood are 0.99, 0.022 and 0.17 w/℃ respectively, determine. 07

i) The rate of heat removal by refrigeration if the total wall area is 85m^2.

ii) The temperature of the inside surface of the brick.

Q.2 a) What are extended surfaces ? Why they are provided ? Write applications of extended surfaces. 06

b) A steel tube 5cm in length, 20 cm ID and 25 cm OD ,is maintained at 120℃ to one end is exposed to the atmosphere at 20℃. Determine the heat loess from the tube neglecting the loss of heat from the end surface and considering there is no convection from inside the tube . Take, h=10w/m^2 k and k =40w/m-k for steel . 07

Q.3 a) Write short note on Graphical method ,for solving 2D heat conduction problem . 05

b) A square plate of side L is fully instulated along the surfaces . the temperatures maintained at edges are given as T(X,O)=0, T(O,Y)=0, T(X,L)=100℃ and T (L,Y)=100℃. Find the exprssion for steady state temperature distribution. 08

Q.4 a) Write note on 'Response of thermocouple' . 05

b) A cylindrical ingot 10 cm diameter and 30cm long passes through a heat treatment furnace which is 6m in length .The ingot must reach a temperature of 800℃ before if comes out of the furnace.The furnace gas is at 1250℃ and ingot initial temperatures is 90℃. What is the maximum speed with which the ingot should move in the furnace to attain the required temperatures ? The combried radiative and convective surface heat transfer coefficient is 100 w/m^2℃ Take K (steel)= 40w/m℃ ,$\propto$ (thermal diffussivity of steel)=1.16$\times$ $10^{-5}m^2$/sec. 08

Q.5 a) Explain with neat diagram Hydroynamic boundary Layer and thermal boundray layer. 07

b) Write note on 'periodic Heat flow'. 06

SECTION-B

Q.6 a) Explain the use of dimensional analysis in convection . 05

b) Air at 20℃ and at atmospleric pressure flows over a flat plate at a veloecity of 1.8 m/sec .If the length of the plate is 2.2m and is maintained at 100℃, Calculate the heat tranfer rate per uint width using 09

i) Exact and

ii) Approximate method .The properties of air at 60℃ are ϱ=1.06kg/m^3,cp=1.005kg/kg℃ k= 0.02894w/m℃ ,pr =0.696, γ =18.97× $10^{-6}m^2$/sec.

Q.7 a) Explain briefly the condensation rnechanism. 06

b) Differenfiate between the mecharism of filmwise and dropwise condensation . 07

Q.8 a) Write design consideration of heat pipe . 05

b) A verfical plate 350mm high and 420mm wide at 40℃, is exposed to saturated steam at 1 atm . 08
Calculate ,

i) The film thicleness at bottom of plate .

ii) The maximum velocity at bottom of plate .

iii) The total heat flux to the plate .

Assume vapour density is small comparqed to that of condensate.

Q.9 a) Write note on 'Atmospheric and solar radiation'. 06

b) What does you understand by 'multimode heat transfer'? Explain 07

Q.10 a) Explain elecfrical network analogy applied to radiation . 06

b) Calculate the net radiant heat exchange per m^2area for two large parallel plates at temperatures of 427℃ and 27℃ respectively . Ɛ For cold plate is 0.6 and Ɛ for hot plate is 0.9. 07
If a polished aluminium shield is placed between them ,find the percentage reduction in heat transfer; Ɛ(Steel)=0.4