Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **M.TECH**
HTPC102

1st Semester Regular/Back Examination – 2015-16
Advanced Heat Transfer
BRANCH(S): THERMAL/HEAT POWER ENGINEERING
Time: 3 Hours
Max marks: 70
Q.CODE:T1048

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

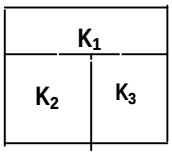
Q1 Answer the following questions: (2 x 10)

a) Why a negative sign is appeared in the Fourier 1-D steady state heat conduction equation?

b) Write the formula of critical radius of insulation for a sphere.

c) When a fin is considered to be a long fin.

d) Draw equivalent electrical circuit of the following system, and find the equivalent conductivity.



e) Define Biot Number, and what its siginificance is.

f) What are the conditions for applying separation of variable method for heat transfer problem?

g) How do you define spectral directional emissivity?

h) Explain about the radiation pressure.

i) Define black and grey bodies.

j) Define extinction efficiency factor for a particle of spherical shape.

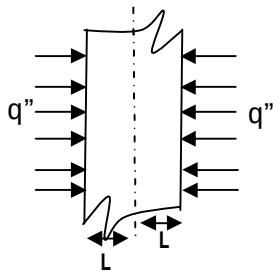
Q2 Under certain environmental conditions, the temperature of human skin (30^oC) is lower than the core temperature of the body (35^oC). The transition between the two temperatures occurs across a sub-skin layer with thickness of 1 cm, which acts as an insulator coat. The thermal conductivity of the living tissue in this layer is 0.42 W/m-K.

(a) Estimate the heat flux that escapes through the skin surface. Treat the sub-skin tissue as a motionless conducting medium. (5)

(b) The ambient air temperature under the same condition is 20^oC. Calculate the heat transfer co-efficient between the skin and ambient air. (5)

Q3 Consider a straight fin of parabolic profile with profile shape $y = C x^2$, where C is a constant. The thermal conductivity, base thickness and length of fin are k, 2b, and L, respectively. The heat transfer coefficient is h, and ambient temperature is T_∞. Find steady sate temperature and total heat transfer from the fin. (10)

Q4 The constant heat flux q" is applied both surfaces of the plate of thickness 2L as shown below. The initial temperature of the plate is T_∞. Find unsteady temperature distribution of the plate. (10)



Q5 A semi-infinite solid having uniform temperature of T_i is suddenly dipped into a fluid medium of temperature $T_0 = T_\infty$. The heat transfer coefficient between the fluid and outer surface of the plate is too large. The plate attains the fluid temperature upon dipping. Find the temperature distribution in the plate. (10)

Q6 The wall of a large incubator for eggs contains an 8 cm thick-layer of fiber glass sandwiched between two plywood sheets with thickness of 1 cm. The outside temperature is $T_c = 10^oC$, and the heat transfer coefficient at outer plywood surface is $h_1 = 5$ W/m^2.K. The corresponding conditions on the wall surface that faces the eggs are $T_h = 40^oC$ and $h_3 = 20$ W/m^2-K. The heat transfer coefficient is higher on warm side of the wall because a fin recalculates the air that comes in contact with the eggs. Calculate the heat flux through the wall of incubator. (10)

Q7 On a clear day the strength of solar radiation has been measured as 800 W/m^2 (normal to the sun's ray), while total sky radiation (from all directions) falling onto a horizontal surface has been determined as 206 W/m^2. Determine illumination onto a horizontal surface if the sun is at Zenith angle of 60o. The spectral intensity varies in the wave length range from 0.4 µm to 0.7 µm. The temperature of sun (T_{sun}) is 5762 K. Given that $f(0.7T_{sun}) = 0.48681$ and $f(0.4Tsun) = 0.12099$. (10)

Q8 Write Short Notes **(Any Two)** (5 x 2)

a) View factor algebra
b) Kirchhoff's Law
c) Fourier's Law of heat conduction with its assumptions