**Registration No:** | | | | | | | | | | |

**Total Number of Pages: 2**

**M.TECH**
**HTPC102/ TFPC102**

# 1st Semester Regular/Back Examination – 2014
## ADVANCED HEAT TRANSFER - I
### BRANCH(S): THERMAL POWER ENGINEERING,THERMAL ENGINEERING,HEAT POWER ENGINEERING,HEAT POWER & THERMAL ENGINEERING, MECHANICAL ENGINEERING (THERMAL & FLUID ENGINEERING),THERMAL & FLUID ENGINEERING

**Time: 3 Hours**
**Max Marks: 70**

**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 ice has very high emissivity?
b) Write the difference between gray and black body.
c) Write the difference between scattering and absorption of participating medium and define extinction coefficient.
d) Draw the temperature profile inside a slab having variable thermal conductivity.
e) Write the surface resistance and shape resistance for a thermal radiation system.
f) Differentiate between diffusivity and thermal capacity of a lumped system.
g) Explain green house effect pertaining to green house gases.
h) Differentiate between Wein's displacement law and Plank's Law.
i) Differentiate between Biot Number and Nusselt Number.
j) Define the critical thickness of insulation with a neat diagram.

Q2 a) A refrigerant at $30^0$C flows in a copper pipe of Inner and Outer diameter 10mm and 14mm respectively. A 40mm thick wall of thermocole is put on the pipe to reduce heat losses. Estimate the heat leakage to the refrigerant per meter length of pipe. Calculate the amount of refrigerant evaporated per hour for latent heat of refrigerant at $30^0$C is 1500kJ/kg.Assume the thermal conductivity of copper and thermocole is 400W/m.K and 0.03W/mK.The internal and external heat transfer coefficients are 500 and 5 W/$m^2$K.Ambient temperature is $40^0$C. (5)

b) Derive the conduction equation for an anisotropic medium. (5)

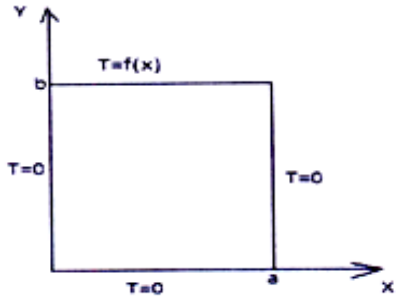
Q3 a) In a petrol engine the heat dissipated through the piston crown is about 3kW.Estimate the minimum crown thickness required for an aluminium piston(k=150W/mK) if the maximum temperature of the piston is limited to $250^0$C and the coolant temperature is $50^0$C . Derive the formulae used (10)

b) Derive the equation of heat dissipation for a short fin with finite length

Q4 a) A stainless steel rod of outer diameter 1cm originally at a temperature of $300^0$C is suddenly immersed in a liquid at $120^0$C for which the convective heat transfer coefficient is 50W/$m^2$K.Determine the time required for the rod to reach a temperature of $100^0$C.Assume the density of steel 7800kg/$m^3$,Specific heat as 450J/kgK and thermal conductivity 40W/mK. (5)

b) Derive the formulae used to solve the above problem. (5)

Q5 Compute the temperature distribution T(x,y) for a rectangular plate of unit thickness as shown (10)




For $f(x) = T_0 \sin\frac{nx}{a}$ where $T_0$ is the constant temperature. Also determine the heat flux of the boundary surfaces.



Q6 a) From the first principle derive the conduction equation for a spherical coordinate system. (5)

b) Derive the radial heat transfer equation for a hollow sphere with constant temperature boundary and show the conductive resistance and mean area of heat flow (5)

Q7 Derive the Radiative Transfer Integro differential Equation for a participating media. (10)

Q8 Explain the followings: (2.5 x 4)

a) Radiosity and Irradiation
b) Duhamel's superposition integral
c) Laplace transform of a transient one dimensional conduction heat transfer equation
d) Radiation shield