KERALA AGRICULTURAL UNIVERSITY
B.Tech.(Agrl. Engg.) 2020 Admission
IV Semester Final Examination - August 2022

Fape.2203 **Heat and Mass Transfer (2+0)** **Marks: 50**
Time: 2 hours

I **Fill in the blanks** **(10x1=10)**

1. Unit of thermal resistance is .....
2. The value of critical radius in the case of a cylindrical object is.....
3. The ratio of kinematic viscosity to thermal diffusivity known as.....
4. In free convection Nusselt number is a function of Grashof number and Prandtl number where as in forced convection, Nusselt number is a function of .....
5. Geometric configuration factor between two infinite parallel plate, separated by a distance is .....
6. The ratio of convective mass transfer to mass diffusion rate is called .....

State True or False

7. If Prandtl Number =1, The thickness of the thermal and hydro dynamic boundary layers will be equal.
8. Grey body is one whose absorptivity does vary with the variation temperature and wavelength of incident ray.
9. In a parallel flow heat exchanger the hot and cold fluid will flow through a coaxial tube in opposite direction.

Define

10. Emissivity

II **Write short notes on ANY FIVE of the following** **(5x2=10)**

1. State Fourier's law of Heat conduction.
2. Summarize the applications of fins/extended surfaces.
3. State Newton's law of cooling.
4. Explain the physical significance of Reynolds's number.
5. State Stefan Boltzmann law of Radiation.
6. Define the term black body.
7. State Fick's law of mass diffusion.

III **Answer ANY FIVE of the following** **(5x4=20)**

1. Explain the significance of critical radius of insulation.
2. The walls of a house, 4 m high, 5 m wide and 0.3 m thick are made from brick with thermal conductivity of 0.9 W/m.K. The temperature of air inside the house is 20°C and outside air is at −10°C. There is a heat transfer coefficient of 10 $W/m^2.K$ on the inside wall and 30 $W/m^2.K$ on the outside wall. Calculate total heat transfer rate through the wall.
3. With a neat sketch explain the hydrodynamic boundary layer over a flat plate.
4. Define following dimensional numbers
   a) Reynolds's number
   b) Prandtl Number
   c) Nusselt Number
   d) Grashoff's Number

5. Calculate the following quantities for an industrial furnace (black body) emitting radiation at 2650°C.
   (i) Total emissive power
   (ii) Total emissive power of the furnace, if it is treated as gray and diffuse body with an emissivity of 0.9
6. A 5 cm diameter sphere at 600°C is placed near an infinite wall at 100°C. Both surface are black. Calculate the net radiant heat transfer between the two bodies.
7. Summarize Reynolds's Analogy.

IV **Write an essay on ANY ONE of the following** **(1x10=10)**

1. Derive the three dimensional heat conduction in Cartesian coordinates.
2. Derive the equation for LMTD for a parallel flow heat exchanger.

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