Code No: R05320306 **R05** **Set No. 2**

III B.Tech II Semester Examinations,December 2010
HEAT TRANSFER
Common to Mechanical Engineering, Automobile Engineering
Time: 3 hours **Max Marks: 80**
Answer any FIVE Questions
All Questions carry equal marks
⋆⋆⋆⋆⋆

1. (a) Sheets of brass and steel, each of thickness 1cm, are placed in contact. The outer surface of brass is kept at 100^0C and the outer surface of steel is kept at 0^0C. What is the temperature of the common interface?
The thermal conductivities of brass and steel are in the ratio of 2:1.
   (b) How long will it take to form a thickness of 4cm of ice on the surface of a lake when the air temperature is -6^0C take K of ice = 1.675 W/mk and its density = 920 kg/m^3. Take the latent heat of fusion of ice as 335 kJ/kg. [6+10]

2. (a) Derive momentum equation for hydrodynamic boundary layer over a flat plate.
   (b) Show by dimensional analysis for free convection Nu= f(Pr, Gr). [8+8]

3. (a) A 10cm dia. cylindrical bar heated in the furnace to a temperature of 200^0C is allowed to cool in an environment with convection coefficient of 150 W/m^2k and temperature of 40^0C. Determine
      i. The time required to cool the centre of the bar to 50^0C
      ii. Temperature of the surface at this instant. For the material of the bar, k = 50 W/m.k and thermal diffusivity 2×10^{-5} m^2/sec.
   (b) The Biot number during a heat transfer between to a sphere and its surroundings is found to be 0.02. Would you prefer lumped system analysis or transient temperature charts when determining the centre temperature of the sphere ? why? [10+6]

4. (a) The heat transfer coefficient is less in natural convection compared to forced convection. Why?
   (b) A square plate 0.5 m × 0.5 m with one surface insulated and the surface is maintained at a uniform temperature of 385 K, which is placed in quiescent air at atmospheric pressure and 315 K. Calculate the average heat transfer coefficient for natural convection when the plate is vertical. [4+12]

5. (a) What do you mean by fouling factor? What are the causes of fouling?
   (b) A double pipe heat exchanger is constructed of a stainless steel (k = 15.1 W/mK) inner tube of D_i = 15 mm and D_o = 19 mm and the outer tube of diameter 32 mm. The convective heat transfer coefficient is given to be $h_i = 800W/m^2K$ and $h_o = 1200W/m^2K$. For a fouling factor of $R_{fi} = 0.0004m^2K/W$ on the tube side and $R_{fo} = 0.0001m^2K/W$ on the shell side, determine
      i. The total thermal resistance

ii. Ui and

iii. U_o of the heat exchanger. [4+12]

6. (a) Sketch various types of fin configurations?

   (b) Aluminum fins of rectangular profile are attached on a plane wall with 5 mm spacing. The fins have thickness 1 mm, length = 10 mm and the normal conductivity K = 200 W/mk. The wall is maintained at a temperature of 200^0C and the fins dissipate heat by convection into ambient air at 40^0C, with heat transfer coefficient = 50 W/m^2k. Find the heat loss. [6+10]

7. Saturated steam at atmospheric pressure condenses on a horizontal copper tube of 25 mm inner diameter and 29 mm outer diameter through water flows at the rate of 25 kg/min entering at 30^oC and leaving at 70^oC. Making necessary assumptions, calculate

   (a) The condensing heat transfer coefficient

   (b) The inside heat transfer coefficient

   (c) The length of the tube. [16]

8. (a) How does an enclosure with a small hole in it behave as a black body.

   (b) Define total emissive power and monochromatic emissive power of a body

   (c) Derive Wien's displacement law λ_{max} T = 2.898 $\times 10^{-3}$ mK from Planck's equation. [4+4+8]

⋆⋆⋆⋆⋆

Code No: R05320306 **R05** **Set No. 4**

III B.Tech II Semester Examinations,December 2010
HEAT TRANSFER
Common to Mechanical Engineering, Automobile Engineering
Time: 3 hours **Max Marks: 80**
Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. (a) How does an enclosure with a small hole in it behave as a black body.
   (b) Define total emissive power and monochromatic emissive power of a body
   (c) Derive Wien's displacement law λ_{max} T = 2.898 $\times 10^{-3}$ mK from Planck's equation. [4+4+8]

2. (a) What do you mean by fouling factor? What are the causes of fouling?
   (b) A double pipe heat exchanger is constructed of a stainless steel (k = 15.1 W/mK) inner tube of D_i = 15 mm and D_o = 19 mm and the outer tube of diameter 32 mm. The convective heat transfer coefficient is given to be $h_i = 800W/m^2K$ and $h_o = 1200W/m^2K$. For a fouling factor of $R_{fi} = 0.0004m^2K$/W on the tube side and $R_{fo} = 0.0001m^2K$/W on the shell side, determine
      i. The total thermal resistance
      ii. Ui and
      iii. U_o of the heat exchanger. [4+12]

3. (a) Sheets of brass and steel, each of thickness 1cm, are placed in contact. The outer surface of brass is kept at 100^0C and the outer surface of steel is kept at 0^0C. What is the temperature of the common interface?
   The thermal conductivities of brass and steel are in the ratio of 2:1.
   (b) How long will it take to form a thickness of 4cm of ice on the surface of a lake when the air temperature is -6^0C take K of ice = 1.675 W/mk and its density = 920 kg/m^3. Take the latent heat of fusion of ice as 335 kJ/kg. [6+10]

4. Saturated steam at atmospheric pressure condenses on a horizontal copper tube of 25 mm inner diameter and 29 mm outer diameter through water flows at the rate of 25 kg/min entering at 30^oC and leaving at 70^oC. Making necessary assumptions, calculate
   (a) The condensing heat transfer coefficient
   (b) The inside heat transfer coefficient
   (c) The length of the tube. [16]

5. (a) The heat transfer coefficient is less in natural convection compared to forced convection. Why?

(b) A square plate 0.5 m $\times$ 0.5 m with one surface insulated and the surface is maintained at a uniform temperature of 385 K, which is placed in quiescent air at atmospheric pressure and 315 K. Calculate the average heat transfer coefficient for natural convection when the plate is vertical. [4+12]

6. (a) A 10cm dia. cylindrical bar heated in the furnace to a temperature of 200^0C is allowed to cool in an environment with convection coefficient of 150 W/m^2k and temperature of 40^0C. Determine

   i. The time required to cool the centre of the bar to 50^0C

   ii. Temperature of the surface at this instant. For the material of the bar, k = 50 W/m.k and thermal diffusivity 2×10^{-5} m^2/sec.

   (b) The Biot number during a heat transfer between to a sphere and its surroundings is found to be 0.02. Would you prefer lumped system analysis or transient temperature charts when determining the centre temperature of the sphere ? why? [10+6]

7. (a) Sketch various types of fin configurations?

   (b) Aluminum fins of rectangular profile are attached on a plane wall with 5 mm spacing. The fins have thickness 1 mm, length = 10 mm and the normal conductivity K = 200 W/mk. The wall is maintained at a temperature of 200^0C and the fins dissipate heat by convection into ambient air at 40^0C, with heat transfer coefficient = 50 W/m^2k. Find the heat loss. [6+10]

8. (a) Derive momentum equation for hydrodynamic boundary layer over a flat plate.

   (b) Show by dimensional analysis for free convection Nu= f(Pr, Gr). [8+8]

⋆⋆⋆⋆⋆

Code No: R05320306 **R05** **Set No. 1**

III B.Tech II Semester Examinations,December 2010
HEAT TRANSFER
Common to Mechanical Engineering, Automobile Engineering
Time: 3 hours **Max Marks: 80**
Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. (a) The heat transfer coefficient is less in natural convection compared to forced convection. Why?
   (b) A square plate 0.5 m × 0.5 m with one surface insulated and the surface is maintained at a uniform temperature of 385 K, which is placed in quiescent air at atmospheric pressure and 315 K. Calculate the average heat transfer coefficient for natural convection when the plate is vertical. [4+12]

2. (a) Sketch various types of fin configurations?
   (b) Aluminum fins of rectangular profile are attached on a plane wall with 5 mm spacing. The fins have thickness 1 mm, length = 10 mm and the normal conductivity K = 200 W/mk. The wall is maintained at a temperature of 200^0C and the fins dissipate heat by convection into ambient air at 40^0C, with heat transfer coefficient = 50 W/m^2k. Find the heat loss. [6+10]

3. (a) How does an enclosure with a small hole in it behave as a black body.
   (b) Define total emissive power and monochromatic emissive power of a body
   (c) Derive Wien's displacement law λ_{max} T = 2.898 $\times 10^{-3}$ mK from Planck's equation. [4+4+8]

4. (a) A 10cm dia. cylindrical bar heated in the furnace to a temperature of 200^0C is allowed to cool in an environment with convection coefficient of 150 W/m^2k and temperature of 40^0C. Determine
      i. The time required to cool the centre of the bar to 50^0C
      ii. Temperature of the surface at this instant. For the material of the bar, k = 50 W/m.k and thermal diffusivity 2 × 10^{-5} m^2/sec.
   (b) The Biot number during a heat transfer between to a sphere and its surroundings is found to be 0.02. Would you prefer lumped system analysis or transient temperature charts when determining the centre temperature of the sphere ? why? [10+6]

5. (a) What do you mean by fouling factor? What are the causes of fouling?
   (b) A double pipe heat exchanger is constructed of a stainless steel (k = 15.1 W/mK) inner tube of D_i = 15 mm and D_o = 19 mm and the outer tube of diameter 32 mm. The convective heat transfer coefficient is given to be $h_i = 800W/m^2K$ and $h_o = 1200W/m^2K$. For a fouling factor of $R_{fi} = 0.0004m^2K/W$ on the tube side and $R_{fo} = 0.0001m^2K/W$ on the shell side, determine

i. The total thermal resistance

ii. Ui and

iii. U_o of the heat exchanger. [4+12]

6. (a) Sheets of brass and steel, each of thickness 1cm, are placed in contact. The outer surface of brass is kept at 100^0C and the outer surface of steel is kept at 0^0C. What is the temperature of the common interface?
The thermal conductivities of brass and steel are in the ratio of 2:1.

   (b) How long will it take to form a thickness of 4cm of ice on the surface of a lake when the air temperature is -6^0C take K of ice = 1.675 W/mk and its density = 920 kg/m^3. Take the latent heat of fusion of ice as 335 kJ/kg. [6+10]

7. (a) Derive momentum equation for hydrodynamic boundary layer over a flat plate.

   (b) Show by dimensional analysis for free convection Nu= f(Pr, Gr). [8+8]

8. Saturated steam at atmospheric pressure condenses on a horizontal copper tube of 25 mm inner diameter and 29 mm outer diameter through water flows at the rate of 25 kg/min entering at 30^oC and leaving at 70^oC. Making necessary assumptions, calculate

   (a) The condensing heat transfer coefficient

   (b) The inside heat transfer coefficient

   (c) The length of the tube. [16]

⋆⋆⋆⋆⋆

Code No: R05320306 **R05** **Set No. 3**

III B.Tech II Semester Examinations,December 2010
HEAT TRANSFER
Common to Mechanical Engineering, Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Saturated steam at atmospheric pressure condenses on a horizontal copper tube of 25 mm inner diameter and 29 mm outer diameter through water flows at the rate of 25 kg/min entering at 30^oC and leaving at 70^oC. Making necessary assumptions, calculate
   (a) The condensing heat transfer coefficient
   (b) The inside heat transfer coefficient
   (c) The length of the tube. [16]

2. (a) Sheets of brass and steel, each of thickness 1cm, are placed in contact. The outer surface of brass is kept at 100^0C and the outer surface of steel is kept at 0^0C. What is the temperature of the common interface?
   The thermal conductivities of brass and steel are in the ratio of 2:1.
   (b) How long will it take to form a thickness of 4cm of ice on the surface of a lake when the air temperature is -6^0C take K of ice = 1.675 W/mk and its density = 920 kg/m^3. Take the latent heat of fusion of ice as 335 kJ/kg. [6+10]

3. (a) How does an enclosure with a small hole in it behave as a black body.
   (b) Define total emissive power and monochromatic emissive power of a body
   (c) Derive Wien's displacement law λ_{max} T = 2.898 $\times 10^{-3}$ mK from Planck's equation. [4+4+8]

4. (a) A 10cm dia. cylindrical bar heated in the furnace to a temperature of 200^0C is allowed to cool in an environment with convection coefficient of 150 W/m^2k and temperature of 40^0C. Determine
      i. The time required to cool the centre of the bar to 50^0C
      ii. Temperature of the surface at this instant. For the material of the bar, k = 50 W/m.k and thermal diffusivity 2×10^{-5} m^2/sec.
   (b) The Biot number during a heat transfer between to a sphere and its surroundings is found to be 0.02. Would you prefer lumped system analysis or transient temperature charts when determining the centre temperature of the sphere ? why? [10+6]

5. (a) What do you mean by fouling factor? What are the causes of fouling?
   (b) A double pipe heat exchanger is constructed of a stainless steel (k = 15.1 W/mK) inner tube of D_i = 15 mm and D_o = 19 mm and the outer tube

of diameter 32 mm. The convective heat transfer coefficient is given to be $h_i = 800W/m^2K$ and $h_o = 1200W/m^2K$. For a fouling factor of $R_{fi} = 0.0004m^2K/W$ on the tube side and $R_{fo} = 0.0001m^2K/W$ on the shell side, determine

i. The total thermal resistance

ii. Ui and

iii. U_o of the heat exchanger. [4+12]

6. (a) The heat transfer coefficient is less in natural convection compared to forced convection. Why?

   (b) A square plate 0.5 m × 0.5 m with one surface insulated and the surface is maintained at a uniform temperature of 385 K, which is placed in quiescent air at atmospheric pressure and 315 K. Calculate the average heat transfer coefficient for natural convection when the plate is vertical. [4+12]

7. (a) Derive momentum equation for hydrodynamic boundary layer over a flat plate.

   (b) Show by dimensional analysis for free convection Nu= f(Pr, Gr). [8+8]

8. (a) Sketch various types of fin configurations?

   (b) Aluminum fins of rectangular profile are attached on a plane wall with 5 mm spacing. The fins have thickness 1 mm, length = 10 mm and the normal conductivity K = 200 W/mk. The wall is maintained at a temperature of 200^0C and the fins dissipate heat by convection into ambient air at 40^0C, with heat transfer coefficient = 50 W/m^{2}k. Find the heat loss. [6+10]

⋆⋆⋆⋆⋆