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

Total Number of Pages : 02 **B.Tech.**
PCE4I102

4th Semester Regular / Back Examination 2017-18
HEAT TRANSFER
BRANCH : CHEM, PT
Time : 3 Hours
Max Marks : 100
Q.CODE : C1005

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Part – A (Answer all the questions)

Q1 **Answer the following questions: *multiple type or dash fill up type:*** **(2 x 10)**

a) A composite wall consists of three different materialshaving thermal conductivities, k, 2k,4k respectively.The temperature drops across differentmaterialswill be in the ratio
a) 1:1: 1 b) 1: 2: 4 c) 4: 2: 1 d) 2: 4 : 1

b) The unit of overall coefficient of heat transfer is
a) kcal/m^2 b) kcal/hr°C c) kcal/m^2hr °C d) kcal/m hr °C

c) If r1 and r2 are inner and outer radius of hollow cylinder, the heat conduction through the cylinder wall is proportional to
a) (r_2-r_1) b) (r_2-r_1) c) $\log_e(r_2/r_1)$ d) $1/\log_e(r_2/r_1)$

d) Prandtl number for air is
a) 0.65 b) 0.75 c) 6.5 d) 65

e) In natural convection, the Nusselt number is function of
a) Reynolds number b) Grashoff's number
c) Prandtlnumber d) both b) and c) above

f) Value of Stefan Boltzman constant in W/m^2-K^4
a) 4.87×10^{-6} b) 4.87×10^{-8}
c) 5.67×10^{-6} d) 5.67×10^{-8}

g) Which of the following phases of designing of heat exchangers does designer consider corrosive nature of the fluid in?
a) The thermal analysis b) The mechanical design
c) The design for manufacture d) None of the above

h) Which of the following is/are example/s of direct contact type heat exchanger?
a) jet condenser b) desuperheater
c) cooling tower d) all of the above

i) The amount of radiation mainly depends upon
a) temperature of body b) nature of body
c) type of surface of body d) all of the above

j) A blackbody is one which
a) is black in color b) absorbs all incident radiation
c) reflects all incident radiation d) absorbs most of the incident radiation

Q2 **Answer the following questions: *Short answer type:*** **(2 x 10)**

a) What do you mean by critical radius of insulation?

b) What is critical Reynolds number? State its approximate values for flow over a flat plate and through a circular tube.

c) What do you mean by entrance regionand fully-developed region? Draw thevelocity and temperature profiles in boththe regions.

d) Why are triangular or parabolic finsgenerally preferred over the rectangularfins ?

e) Define thermal diffusivity.How does it differ from thermal conductivity?

f) Give expression for (i) Graetz number (ii) Grastof number.

g) Distinguish between film type and dropwise condensation.
h) What are the factors effecting convective heat transfer?
i) Define Reynolds number and its notation.
j) Explain what you meanby absorptivity, reflectivity and transmissivity.

Part – B (Answer any four questions)

Q3 **a)** The wall of a cold storage consists of three layers: an outer layer of ordinary bricks, 25 cm thick, a middle layer of cork, 10 cm thick and an inner layer of cement, 6 cm thick. The thermal conductivities of the materials are 0.7,0.043 and 0.72 W/m. K, respectively. The temperature of outer surface of the wall is 30 °C and that of inner is 15 °C. Calculate : (a) steady state rate of heat gain per unit area, (b) Temperature at the interfaces of composite wall, (c) The percentage of total heat resistance offered by individual layers, and (d) What additional thickness of cork should be provided to reduce the heat gain 30% less than the present value ? **(10)**

b) Prove that the thermal resistance offered by a hollow long cylinder of constant thermal conductivity is given by **(5)**

$$R = \frac{\ln(r2 - r1)}{2\pi Lk}$$

Q4 **a)** Develop an expression for average heat transfercoefficient for laminar film condensation on avertical plate clearly stating the assumptionsmade. **(10)**

b) What is chemical evaporation? Briefly discuss the classification of chemical evaporators. **(5)**

Q5 **a)** Explain different regimes in pool boiling curve with neat sketch. **(7)**

b) Explain the mechanism of convection heat transfer. What are the differences between natural and forced convection? **(8)**

Q6 **a)** Calculate the following quantities for an industrial furnace (black body) emitting radiation at 2650 °. (a) Spectral emissive power at λ=1.2 μm, (b) Wavelength at which the emissive power is maximum, (c) Maximum spectral emissive power, (d) Total emissive power, (e) Total emissive power of the furnace, if it is treated as gray and diffuse body with an emissivity of 0.9. **(10)**

b) State and explain briefly, the law of radiations. **(5)**

Q7 The liquid metal flows at a rate of 270 kg/min through a 5 cm diameter stainless steel tube. It enters at 415 °C and is heated to 440 °C, when it passes through tube. The tube wall temperature is kept 20 °C higher than the liquid bulk temperature and a constant heat flux is maintained along the tube. Calculate the length of the tube required to effect the transfer. Use **(15)**
For constant wall temperature, $Nu = 5.0+0.025\ Pe^{0.8}$
For constant heat flux, $Nu = 4.82+ 00185\ Pe^{0.827}$
Use following properties
$\mu = 1.34 \times 10^{-3}$, C_p=149 J/kg. K, Pr=0.013, k_f=15.6 W/m.K.

Q8 **a)** Derive an expression for calculating the effectiveness of a counter-current flow heat exchanger. **(10)**

b) Classify heat exchangers according to construction type and explain the characteristic of each type with a neat sketch. **(5)**

Q9 **Write short notes on any THREE :** **(5 x 3)**

a) Geometric factor
b) Reynold's-Colburn analogy
c) Hysteresis in the boiling curve
d) Fouling factor