Vidyavardhini's College of Engineering and Technology

Sample Paper TE Mechanical/ (R-2016)/ semester V/ Heat Transfer/ University of Mumbai Online Examinations January 2021

Section 1: Personal details

Section 2: MCQ (20 question 2 marks each, all compulsory)

Q1.	The radial heat transfer rate through hollow cylinder increases as the ratio of outer radius to inner radius (*a*) decreases (*b*) increases (*c*) constant (*d*) none of the above.
	Answer: a
Q2	Conduction is a process of heat transfer from (*a*) a hot body to a cold body, in a straight line, without affecting the intervening medium (*b*) one particle of the body to another without the actual motion of the particles (*c*) one particle of the body to another by the actual motion of the heated particles (*d*) none of the above.
	Answer: b
Q3	The overall coefficient of heat transfer is used in the problems of (*a*) radiation (*b*) conduction (*c*) convection (*d*) conduction and convection.
	Answer: d
Q4	If k is the thermal conductivity, ρ is the mass density and c is the specific heat then the thermal diffusivity of substance is given by (*a*) $\frac{\rho c}{k}$ (*b*) $\frac{k}{\rho c}$ (*c*) $\frac{kc}{\rho}$ (*d*) $\frac{k\rho}{c}$.
	Answer: b

Q5	In transient heat conduction, the two significant dimensionless parameters are .... number and .... number. (*a*) Fourier, Reynolds (*b*) Reynolds, Prandtl (*c*) Biot, Fourier (*d*) Reyonlds, Biot.
	Answer: d
Q6	The degree of approach, in heat exchangers, is defined as the difference between temperatures of (*a*) hot medium outlet and cold water outlet (*b*) hot medium outlet and cold water inlet (*c*) cold water inlet and outlet (*d*) hot medium inlet and outlet.
	Answer: a
Q7	.... is the ratio of total emissive power of body to total emissive power of a black body at the same temperature. (*a*) Emissivity (*b*) Absoptivity (*c*) Transmissivity (*d*) Reflectivity.
	Answer: a
Q8	For infinite parallel planes with emissivities e_1 and e_2, the interchange factor for radiation from surface 1 to surface 2 is (*a*) $\frac{1}{\varepsilon_1 + \varepsilon_2}$ (*b*) $\varepsilon_1 + \varepsilon_2$ (*c*) $\varepsilon_1 - \varepsilon_2$ (*d*) $\frac{\varepsilon_1 \varepsilon_2}{\varepsilon_1 + \varepsilon_2 - \varepsilon_1 \varepsilon_2}$.
	Answer: d

Q9	The relationship $\lambda_{max} T$ = constant, between the temperature of a black body and the wavelength at which maximum value of monochromatic emissive power occurs is known as .... law. (*a*) Lambert's (*b*) Kirchhoff's (*c*) Planck's (*d*) Wien's displacement.
	Answer: d
Q10	With regard to 'Fouling factor' which of the following statements is correct ? (*a*) It is used when a liquid exchanges heat with a gas (*b*) It is used only in case of Newtonian fluids (*c*) It is dimensionless (*d*) It is virtually a factor of safety in heat exchanger design.
	Answer: d
Q11	Grashoff number has significant role in heat transfer by ..... (*a*) conduction (*b*) radiation (*c*) natural convection (*d*) forced convection.
	Answer: c
Q12	In convective heat transfer, the Nusselt number (*a*) represents the ratio of viscous to inertia force (*b*) signifies the velocity gradient at the surface (*c*) is the ratio of molecular momentum diffusivity to thermal diffusivity (*d*) is the ratio of conduction to convection resistance.
	Answer: d

Q13	In case of laminar flow over a plate, the convective heat transfer co-efficient (*a*) decreases with increase in free stream velocity (*b*) increases with distance (*c*) increases if a higher viscosity fluid is used (*d*) increases if a denser fluid is used.
	Answer: d
Q14	Conduction through hollow, radial one dimensional heat transfer is expressed as (*a*) $Q = \frac{2\pi l\ (t_1 - t_2)\ k}{\log_e r_2 / r_1}$ (*b*) $Q = \frac{2\pi l\ (t_1 - t_2)}{k\ (r_2 - r_1)}$ (*c*) $Q = \frac{2\pi l\ \log_e (t_1 / t_2)}{(r_2 - r_1)\ k}$ (*d*) $Q = \frac{2\pi l\ (t_1 - t_2)\ k}{\log_e r_2 / r_1}$.
	Answer: a
Q15	For spheres, the critical thickness of insulation is given by (*a*) $\frac{h}{2k}$ (*b*) $\frac{2k}{h}$ (*c*) $\frac{k}{h}$ (*d*) $\frac{k}{2\pi h}$ where k = thermal conductivity, h = convective heat transfer coeffecient.
	Answer: b

Q16	Compared to parallel flow heat exchanger, LMTD in case of counter-flow heat exchanger is (*a*) lower (*b*) higher (*b*) same (*d*) unpredictable.
	Answer: b
Q17	In .... flow maximum heat transfer rate can be expected. (*a*) laminar (*b*) turbulent (*c*) counter current (*d*) co-current.
	Answer: b
Q18	Why are baffles provided in heat exchangers ? (*a*) To reduce heat transfer rate (*b*) To increase heat transfer rate (*c*) To remove dirt (*d*) To reduce vibrations.
	Answer: b
Q19	On which of the following factors does the heat flux in nucleate pool boiling depend? (*a*) Material of the surface only (*b*) Material and roughness of the surface (*c*) Liquid properties and material of the surface (*d*) Liquid properties, material and condition of the surface.
	Answer: d
Q20	Which of the following terms does not pertain to radiation heat transfer? (*a*) Configuration factor (*b*) Spectral distribution (*c*) Solid angle (*d*) Reynolds analogy.
	Answer: d

Section 3: Attempt any 4 out of 5. (10 marks each)

Q1) A longitudinal copper fin (k=380W/m°C) 600mm long and 5mm diameter is exposed to air stream at 20°C. The convective heat transfer coefficient h is 20W/m^2°C. If the fin base temperature is 150°C, determine: i) the heat transferred in kJ/h and ii) the efficiency of the fin. Assume that fin is insulated at the tip.

Q2) Air at 27°C is flowing across a tube with a velocity of 25m/s. The tube could be either a square of 5cm side or a circular cylinder of 5cm diameter.
Compare:
the rate of heat transfer in each case, if the tube surface is at 127°C.
Use $Nu= C(Re)^{n}(Pr)^{1/3}$.,
Where, C=0.027, n=0.805 for cylinder,
C=0.102, n=0.675 for square tube.
Properties of air at 77°C,
$\rho=0.955 kg/m^3$, $k_f=0.03 W/mk.K$, $\nu=20.92\times10^{-6}\ m^2/s$, Pr=0.7, $C_p=1.009 kJ/kg.K$.

Q3) Show by dimensional analysis for forced convection, Nu=Ø(Re,Pr)

Q4) Steam in a condenser of a steam power plant is to be condensed at a temperature of 30°C with a cooling water from nearby lake, which enters the tube of condenser at 14°C and leaves at 22°C. The surface area of the tubes is $45m^2$ and an overall heat transfer coefficient is 2100 $W/m^2.K$. Calculate the mass flow rate of cooling water needed and rate of steam condensation in the condenser. Treat the condenser as counter flow heat exchanger. C_p of water at 18°C is 4.18kJ/kg.K and latent heat of vaporization at 30°C if $h_{fg}=2430.5 kJ/kg$.

Q5) Calculate the net radiant heat exchange per m^2 area for two parallel plates of temperature 427°C and 27°C respectively Ɛ (hot plate) =0.9 and Ɛ (cold plate) =0.6. If a polished aluminum shield is placed between them, find the % reduction in heat transfer: Ɛ(shield)=0.4.