A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 55A04

B.E./B.Tech. DEGREE EXAMINATION, NOV 2018

Fifth Semester

Agriculture Engineering

15UAG504 – HEAT AND MASS TRANSFER FOR AGRICULTURAL ENGINEERING

(Approved Heat and Mass Transfer Data Book & Steam Tables are allowed)

(Regulation 2015)

Duration: Three hours Maximum:100 Marks

Answer ALL questions

PART - A (10 x 1 = 10 Marks)

1. Unit of Thermal conductivity is CO1- R

   (a) W/m K (b) W/m (c) $W/m^2 K$ (d) $W/m^3 K$

2. _____is the ratio of thermal conductivity and heat capacity CO1- R

   (a) Heat capacity ratio (b) Thermal diffusivity

   (c) Specific heat (d) Biot Number

3. _____ defined as ratio of inertia force to viscous force CO2- R

   (a) Biot Number (b) Prandtl Number

   (c) Grashoff Number (d) Reynolds number

4. The dimensionless numbers involved in Natural convection is/are CO2- R

   (a) Grashoff Number (b) Prandtl number (c) Nusselt Number (d) All of the above

5. Heat transfer mode in film boiling is CO3- R

   (a) Conduction (b) Convection (c) Radiation (d) None of the above

6. In _____ heat exchanger, hot and cold fluid flow in same direction. CO3- R

   (a) Counter flow (b) Parallel flow (c) Cross flow (d) Mixed flow

7. Emissivity of black body is CO4- R

(a) Equal to 1.0 (b) Less than 1 (c) Greater than 10 (d) Greater than 1

8. Radiation shield should have CO4- R

(a) High transimissivity (b) High conductivity

(c) Low reflectivity (d) High reflectivity

9. As per Daltons law of partial pressure total pressure CO5- R

(a) $P = P_a + P_b$ (b) $P = P_a - P_b$ (c) $P = P_a / P_b$ (d) $P = P_a \times P_b$

10. Ficks law states that mass flux is directly proportional to CO5- R

(a) Temperature gradient (b) Concentration gradient

(c) Volume of species (d) Molecular weight

PART – B (5 x 2= 10 Marks)

11. State Fourier law of heat conduction CO1- R

12. Define Grashoff number CO2- R

13. Define burnout point CO3- R

14. List the properties of radiation shield materials CO4- R

15. Write the significance of Sherwood number CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) A furnace wall is made up of silica and magnesite brick. Inside layer is made up of silica brick of 100 mm thick and this layer is covered with magnesite brick of 200 mm thickness. The temperature on the inside surface brick is 700°C and outside surface of magnesite is 100°C. Take K of silica brick is 1.7 W/m K and K of magnesite brick is 5.8 W/m K. Calculate the rate of heat transfer per unit area of the wall and temperature at the interface. CO1- App (16)

Or

(b) An egg with mean diameter of 4 cm and initially at 25°C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumers taste. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at 5°C? Let K=12 W/mK, h = 125W/m^2 K, C =2 kJ/kg K, ρ = 1250 kg/m^3. CO1- App (16)

17. (a) Assuming that a man can be represented by a cylinder 350 mm in diameter and 1.65 high with a surface temperature of 28°C. Calculate the heat he would lose while standing in a 30 km/h at 12°C. CO2- App (16)

Or

(b) Calculate the heat transfer from a 60W incandescent bulb at 115^{o}C to ambient air at 25^{o}C. Assume the bulb as a sphere of 50 mm diameter. Also find the percentage of power lost by free convection. CO2- App (16)

18. (a) Water at atmospheric pressure is to be boiled in polished copper pan. The diameter of the pan 300 mm and is kept at 110°C. Calculate the following:
(i) Power of the burner
(ii) Rate of evaporation in kg/hr
(iii) CHF CO3- Ana (16)

Or

(b) A counter flow double pipe heat exchanger is used to heat water from 20^{o}C to 40^{o}C by cooling an oil from 90^{o}C to 55^{o}C. The exchanger is designed for a total heat transfer rate of 59 kW with overall heat transfer coefficient of 340W/m^{2}K. Calculate the surface area required. CO3- App (16)

19. (a) Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2500°C.
(i) Monochromatic emissive power at 1.2μm length
(ii) Wavelength at which the emission is maximum
(iii) Maximum emissive power
(iv) Total emissive power
(v) Total emissive power of the furnace if it is assumed as a real surface with emissivity equal to 0.9 CO4- U (16)

Or

	(b)	Calculate the net radiant heat exchange per m² area for two large parallel plates at temperatures of 427°C and 27°C respectively. Effectiveness of hot plate and cold plate 0.9 and 0.6 respectively. If a polished aluminium shield is placed between them, find the percentage reduction in heat transfer, emissivity of the shield is 0.4	CO4- Ana	(16)
20.	(a)	A vessel contains a binary mixture of O_2 and N_2 with partial pressure in the ratio 0.21 and 0.71 at 15°C. The total pressure of the mixture is 1.1 bar. Calculate the following: (i) Molar concentration (ii) Mass density (iii) Mass fraction iv)Molar fractions of each species and what would be the average molecular weight of the mixture.	CO5- Ana	(16)
		Or		
	(b)	(i)Air at 20°C with a velocity of 3.5 m/s flows over a flat plate. If the plate is 0.5 m long, calculate the mass transfer coefficient.	CO5- U	(8)
		(ii) Determine diffusion rate of water from bottom of a test tube of 35 mm diameter and 55 mm long into dry air at 30°C. Take diffusion coefficient of water in air as $0.28x10^{-4}$ m²/sec	CO5- U	(8)