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

Question Paper Code: 55A04

B.E./B.Tech. DEGREE EXAMINATION, DEC 2021

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. In case of liquids and gases, the heat transfer takes place according to CO1- R

   (a) Conduction. (b) Convection. (c) Condensation. (d) Radiation.

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. The ratio of heat transfer by convection and heat transfer by conduction is called CO2- R

   (a) Reynolds number. (b) Prandtl number

   (c) Nusselt number. (d) Grashof 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. The emissivity for black body is CO3- R

   (a) 0. (b) 0.5. (c) 0.75. (d) 1.

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. Fouling factor is used CO4- R

(a) In heat exchanger design as a safety factor.

(b) In case of Newtonian fluids.

(c) When a liquid exchanges heat with a gas.

(d) In case of non-Newtonian fluids.

8. Radiation shield should have CO4- R

(a) High transimissivity (b) High conductivity

(c) Low reflectivity (d) High reflectivity

9. The unit of mass flow rate is CO5- R

(a) kg. (b) kJ/s. (c) kg/s. (d) N.

10. The ratio of molecular diffusivity of momentum and molecular diffusivity of mass is called CO5- R

(a) Fick's law. (b) Schmidt Number.

(c) Scherwood Number. (d) Eddy diffusion.

PART – B (5 x 2= 10 Marks)

11. Define fins (or) extended surfaces. CO1- R

12. What is difference between free convection and forced convection? CO2- R

13. Define burnout point CO3- R

14. What is meant by pool boiling? CO4- R

15. State Fick's law of diffusion. CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) A wall of 0.6 m thickness having thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material having an average thermal conductivity of 0.3 W/mK. Inner and outer surface temperature is 1000^0C and 10^0C respectively. If heat transfer rate is 1400 W/m^2. Calculate the thickness of insulation. CO1- App (16)

Or

(b) An egg with mean diameter of 4 cm and initially at 25^{o}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^{o}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)	Air at 25^0 C flows over a flat plate at a speed of 5 m/s and heated to 135^0 C. The plate is 3 m long and 1.5 m wide. Calculate the local heat transfer coefficient at x= 0.5 m and the heat transferred from the first 0.5 m of the plate.	CO2- App	(16)
		Or		
	(b)	Calculate the heat transfer from a 60W incandescent bulb at 115°C to ambient air at 25°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)	Two large parallel plates are maintained at a temperature of 900 K and 500 K respectively. Each plate has an area of 6 m^2. Compare the net heat exchange between the plates for the following cases: (a) Both plates are black and (b) Plates have an emissivity of 0.5.	CO3- Ana	(16)
		Or		
	(b)	A counter flow double pipe heat exchanger is used to heat water from 20°C to 40°C by cooling an oil from 90°C to 55°C. The exchanger is designed for a total heat transfer rate of 59 kW with overall heat transfer coefficient of 340W/m^2K. Calculate the surface area required.	CO3- App	(16)
19.	(a)	In a counter flow double pipe heat exchanger, water heated from 25^0 C to 65^0 C by oil with a specific heat of 1.45 KJ/KgK and mass flow rate is 0.9 Kg/s. The oil is cooled from 230^0 C to 160^0 C. If the overall heat transfer co-efficient is 420 W/m^2 ^{0}C, Calculate the following: (a) The rate of heat transfer, (b) The mass flow rate of water and (c) The surface area of the heat exchanger.	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)	Helium diffuses through a plate membrane of 2 mm thick. At the inner side the concentration of helium is 0.025 Kg mole/m^3. At the outer side the concentration of helium is 0.007 Kg mole/m^3. What is the diffusion flux of helium through the membrane? Assume diffusion co-efficient of helium with respect to plastic is 1 X10^{-9} m^2/s.	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)