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

Question Paper Code: 55A04

B.E./B.Tech. DEGREE EXAMINATION, NOV 2019

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. The heat is transferred by conduction, convection and radiation in CO1- R

   (a) Melting of ice (b) Boiler furnaces

   (c) Condensation of steam in condenser (d) None of these

2. The unit of overall coefficient of heat transfer is CO1- U

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

3. Which of the following is an example of forced convection? CO2-U

   (a) Chilling effect of cold wind on a warm body

   (b) Flow of water in condenser tubes

   (c) Cooling of billets in the atmosphere

   (d) Heat exchange on cold and warm pipes

4. The natural convection air cooled condensers are used in CO2-U

   (a) Domestic refrigerators (b) Water coolers

   (c) Room air conditioners (d) All of these

5. Stefan Boltzmann law is applicable for heat transfer by CO3- R

   (a) Conduction (b) Convection

   (c) Radiation (d) Conduction and radiation combined

6. Electrical analogy for heat transfer coefficient is CO3- U

(a) Resistance (b) Inductance (c) Unit conductance (d) Capacitance

7. In a heat exchanger with one fluid evaporating or condensing, the surface area required is least in CO4- R

(a) Parallel flow (b) Counter flow (c) Cross flow (d) All of these

8. LMTD in case of counter flow heat exchanger as compared to parallel flow heat exchanger is CO4- R

(a) Higher (b) Lower

(c) Depends on the area of heat exchanger (d) Same

9. What is the unit of mass diffusion coefficient? CO5- R

(a) m^2/s (b) kg m/s^2 (c) m^2 s (d) kg s/m^2

10. Which of the following plays an important role in problems of simultaneous heat and mass transfer ? CO5- R

(a) Lewis number (b) Schmidt number (c) Prandtl number (d) Sherwood number

PART – B (5 x 2= 10 Marks)

11. State Fourier's Law of conduction. CO1- R

12. Compare laminar flow and turbulent flow. CO2- U

13. What is the purpose of radiation shield? CO3- R

14. List the types of heat exchangers. CO4- R

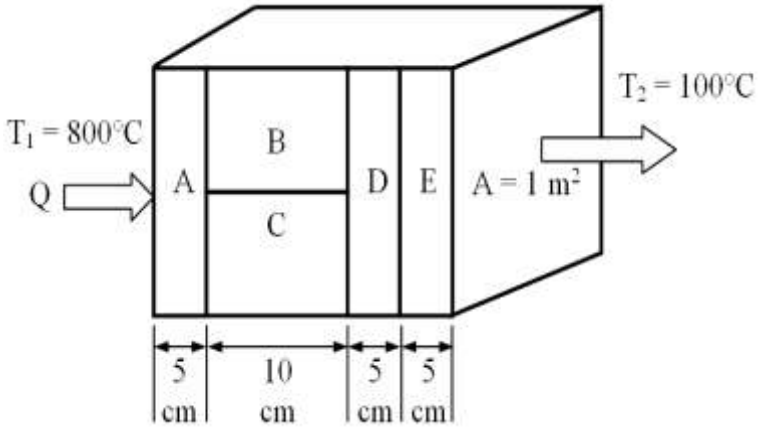
15. State Fick's law of diffusion. CO5- R

PART – C (5 x 16= 80 Marks)

16. (a) Derive the General Differential Equation of heat Conduction in Cartesian coordinates. CO1- App (16)

Or

(b) Determine the heat transfer through the composite wall shown in figure. Take the conductivities of A, B, C, D and E as 50, 10, 6.67, 20 & 30 W/mK respectively. Assume one dimensional heat transfer with unit cross section. CO1- App (16)



17. (a) Explain in detail about the boundary layer concept. CO2-U (16)

Or

(b) In a staggered tube bank, water is passed through the tubes while the air is passed in cross flow over the tubes. There are seven rows of tubes in the air flow direction. The temperature and velocity of air are 15°C and 6 m/s respectively. The longitudinal and transverse pitches are both equal to 20.5 mm. The tube outside diameter is 16.4 mm and tube surface temperature is 70°C. Calculate the air side heat transfer coefficient and the pressure drop across the tube bundle CO2-U (16)

18. (a) A black body at 3000 K emits radiation. Calculate the following: CO3- Ana (16)

(i) Monochromatic emissive power at 1 μm wavelength

(ii) Wavelength at which emission is maximum

(iii) Total emissive power

Total emissive power of the furnace if it is assumed as a real surface having emissivity = 0.85

Or

(b) Two parallel plates of size 1.0 m x 1.0 m spaced 0.5 m apart are located in very large room , the walls of are maintained at a temperature of 27^0C . one plate is maintained at a temperature of 900^0C and other at 400^0C . Their emissivity are 0.2 and 0.5 respectively .if the plate exchange heat between themselves and surroundings , find the net heat transfer to each plate and to the room . Consider only the plate surface facing each other. CO3- Ana (16)

19. (a) A counter flow concentric tube heat exchanger is used to cool engine oil (C=2130 J/kgK) from 160°C to 60°C with water available at 25°C as the cooling medium. The flow rate of cooling water through the inner tube of 0.5 m diameter is 2 kg/s while the flow rate of oil through the outer annulus O.D is 0.7 m is also 2 kg/s. If the value of the overall heat transfer coefficient is 250 W/m^2K, how long must the heat exchanger to be meet its cooling requirement? CO4- App (16)

Or

(b) A refrigerator is designed to cool 250 kg/h of hot liquid of specific heat 3350 J/kg K at 120°C using a parallel flow arrangement. 1000 kg/h of cooling water is available for cooling purpose at a temperature of 10°C. If the overall heat transfer coefficient is 1160 W/m^2K and the surface area of the heat exchanger is 0.25 m^2, Calculate the outlet temperature of the cooled liquid and water and also the effectiveness of the heat exchanger. CO4- App (16)

20. (a) Oxygen at 25^oC and pressure of 2 bar is flowing through a rubber pipe of inside diameter 25mm and wall thickness 2.5 mm. The diffusivity of O_2 through rubber is 0.21 $X10^{-2}$ m^2/s and the solubility of O_2 in rubber is 3.12 $X10^{-3}$ k mole/ m^3 bar . Find the loss of O_2 by diffusion per metre length of pipe. CO5- App (16)

Or

(b) The water in a 5 m x 15 m outdoor swimming pool is maintained at a temperature of 27°C. The average ambient temperature and relative humidity are 27°C and 40% respectively. Assuming a wind speed of 2 m/s in the direction of the long side of the pool. Estimate the mass transfer coefficient for the evaporation of water from the pool surface. CO5- App (16)