****

**UNIVERSITY**

(Karunya Institute of Technology & Sciences)

(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_\_

**End Semester Examination – Nov/Dec - 2016**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Semester :** | **2016-17 ODD** |
| **Code :** | **12BT208** | **Duration :** | **3 hrs** |
| **Sub. Name :** | **HEAT TRANSFER OPERATIONS** | **Max. marks :** | **100** |

|  |  |  |
| --- | --- | --- |
| **Q. No.** | **Questions** | **Marks** |
| **PART-A(10X1=10 MARKS)** | | |
| 1. | Thermal conductivity is expressed as\_\_\_\_\_\_ | (1) |
| 2. | Rate of heat transfer per unit area is called \_\_\_\_\_\_\_\_\_\_\_\_. | (1) |
| 3. | Define the expression of the Reynold’s Number. | (1) |
| 4. | List the types of Boiling. | (1) |
| 5. | What is the expansion of 2-3 Heat exchanger? | (1) |
| 6. | State the LMTD. Give its significance. | (1) |
| 7. | What is steam economy? | (1) |
| 8. | What are the feeding methods available? | (1) |
| 9. | List the 2 types of condensation. | (1) |
| 10. | Unit of heat transfer coefficient is \_\_\_\_\_\_\_\_\_\_\_\_. | (1) |

|  |  |  |
| --- | --- | --- |
| **PART B(5 X 3= 15 MARKS)** | | |
| 11 | State and explain Kirchoff’s Law of radiation. | (3) |
| 12 | State and explain the Fourier’s Law. | (3) |
| 13 | Define fouling factor and list out its prevention method. | (3) |
| 14 | Write down the mass balance equation for single effect evaporator at steady state conditions. | (3) |
| 15 | Differentiate between drop wise condensation and film wise condensation. | (3) |

|  |  |  |  |
| --- | --- | --- | --- |
| **PART C(5 X 15= 75 MARKS)** | | | |
| 16. | a. | Derive the expression for heat transfer through a furnace wall made of three different materials in series. Assume k1, k2 and k3 be the thermal conductivities of materials and x1, x2 and x3 be the respective thickness. Assumehot face and cold facetemperatures be T1 and T2 respectively**.** | (8) |
|  | b. | A 60 mm diameter pipe of circular cross section and with walls 3.5mm thick is covered with two concentric layers of logging. The inner layer has a thickness of 23mm and thermal conductivity of 0.05 (W/m K) and outer layer has thickness of 40 mm and thermal conductivity of 0.03 (W/m K). Estimate the rate of heat loss per metre length of pipe. The temperature inside the pipe is 500K and outside surface temperature is 275K. Thermal conductivity for the pipe is 40(W/m K). | (7) |
| (OR) | | | |
| 17. | a. | A furnace is constructed with 220mm thick of fire brick, 122mm of insulating brick and 225 mm of the building brick. The inside temperature is 1230 K and the outside temperature is 320K. Find the heat loss per unit area and the temperature of the junction of the fire brick and insulation brick. Data: Thermal conductivity of fire brick= 1.4 (W/m K), Thermal conductivity of insulating brick= 0.2 (W/m K) and Thermal conductivity of building brick= 0.7 (W/m K). | (10) |
|  | b. | Derive the expression of plane wall with variable thermalconductivity. | (5**)** |
| 18. | a. | Explain about temperature gradient in forced convection with a suitable diagram. | (7) |
|  | b. | Derive a relationship for heat transfer coefficient, h for forced convection of heat transfer. h= f (ρ, µ, u, L, Cp, k). | (8) |
| (OR) | | | |
| 19. | a. | Write in detail on Heat Exchangers | (10) |
|  | b. | Write a note on Grey body and black body. | (5**)** |
| 20. | a. | Discuss the merits and demerits of a heat exchanger. | (5) |
|  | b. | Water enters as two fluids in a heat exchanger at 55ºC and leaves at 85ºC. Hot gases enter at 305 ºC and leave at 160 ºC. If the total heat transfer area is 500 square metre and the overall heat transfer coefficient is 600 kcal/hrm2ºC, determine the total heat transferred per hour for: i. Parallel flow ii. Counter flow. | (10) |
| (OR) | | | |
| 21. | a. | Discuss about the design of shell and tube heat exchanger (1-1) with a neat sketch. | (7) |
|  | b. | What is Radiation? and explain all the laws of Radiation. | (8) |
| 22. | a. | Differentiate between natural evaporation and forced evaporation. | (3) |
| b. | Calculate the amount of steam required for concentrating the solution of caustic soda from 28% by weight of solids to 40% by weight of solids in a single effect evaporator. The feed rate in 25000 kg / hr and its temperature is 60 ºC. The absolute pressure in the evaporator is 0.2 kg/cm2. Saturated steam at 1.4 kg/ cm2 is to be used as heating medium. The elevation in boiling points is 25 ºC. If the overall heat transfer coefficient is 670 kcal/ hr m2 ºC, calculate the heating surface required. The enthalpy data for various streams are as follows: Vapour at 0.2 kg/ cm2  = 623 kcal/ kg. 20% NaOH at 60 ºC = 50 kcal / kg, 40% NaOH at 85 ºC = 90 kcal / kg. Latent heat of steam at 1.4 kg/ cm2  =534 kcal / kg. | (12) |
| (OR) | | | |
| 23. | a. | Discuss about a single effect evaporator energy balance with a suitable sketch. | (5) |
|  | b. | Explain Multiple feed evaporators with the three types of Feed | (10) |
| 24. |  | Discuss in detail the boiling mechanisms and the principle concerned with it. | (15) |
| (OR) | | | |
| 25. |  | Evaluate the inside heat transfer coefficient. Heavy oil flows at a rate of 0.5Kg/s through a tube of 19mm inside diameter and is heated from 311 to 327K by condensing steam at 373K.  **Data:** Mean / average oil temperature: 319K,  K for oil = 0.14W/mk  Cp for oil = 2.1KJ/Kg.K  µ for oil = 154(m.N.s)/m2  µ at mean wall temperature (346k)= 87.0 (m.N.s)/m2  Length of tube = 1.5m | (15) |

ALL THE BEST