Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Winter Semester: 2021 - 22
Course Code: MEC 209
Course Name: Heat and Mass Transfer
Program & Sem: B.Tech. & VI

Date: 25th April 2022
Time: 1.30 PM to 2.30 PM
Max Marks: 30
Weightage: 15%

Instructions:
(i) Read the all questions carefully and answer accordingly.
(ii) Use of Non-programmable calculator is allowed.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries ONE marks. (10Qx 1M= 10M)

1. Which of the following is the rate of heat transfer unit..... (C.O.1) [Knowledge]

A. Watt B. Pascal C. Joule D. Newton

2. Which of the following is an example of steady-state heat transfer . . (C.O.1) [Knowledge]

. A. Boilers and turbines B. Cooling of I.C engine

C. Chilling effect of cold wind on a warm body

D. Electric bulb cools down by the surrounding atmosphere

3. Which way is heat transfer believed to take place in a long, hollow cylinder that is kept at consistent but varied temperatures on its inner and outer surfaces? (C.O.1) [Knowledge]

A. Unpredictable B. Radial only C. No heat transfer takes place D. Axial only

4. Insulators are good conductor of heat (True/False) (C.O.1) [Knowledge]

5. Conduction is NOT possible in gases. (True/False) (C.O.1) [Knowledge]

6 Fourier's law is used for..... Conduction heat transfer (C.O.1) [Knowledge]

A. One dimension cases B. Two dimension cases C. Irregular surface D. Any Surface

7. Unit of thermal Resistence is …… (C.O.1) [Knowledge]

A. Watt/metre-Kelvin B. metre-Kelvin/Watt C. Watt/metre2-Kelvin D. None

8. Thermal conductivity of solid substance is more than liquid but less than gases. (True/False) (C.O.1) [Knowledge]

9. Which of the following is a method of heat transfer. (C.O.1) [Knowledge]

a) Convection b) Radiation c) Conduction d) All of the mentioned

10. Good conductor of electricity are generally bad conductor of heat due to presence of free electrons.(True/False) (C.O.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries FOUR marks. (2Qx4M=8M)

11. Explain with neat diagram the concept of critical radius of Insulation and its importance.

(C.O.1) [Comprehension]

12. Derive with a neat diagram the Fourier law of Conduction.

(C.O.1) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries SIX marks. (2Qx6M=12M)

Q.NO. 13. Steady one-dimensional heat conduction takes place across the faces 1 and 3 of a composite slab consisting of slabs A and B in perfect contact as shown in figure 1, where kA, kB denote the respective thermal conductivities. Using the data as given in the figure, Find the interface temperature T2 (in◦C). Assume the cross-sectional area of each slab as 1 m^2.

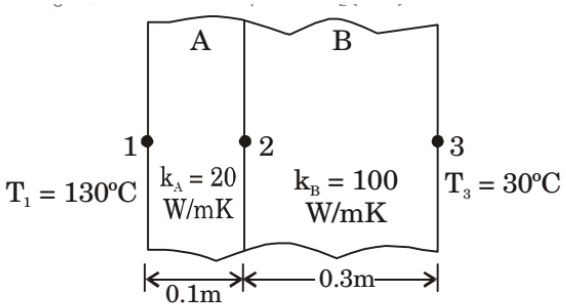

Figure 1

(C.O.1) [Application]

Q.NO. 14. A plane wall of 10 cm thickness and 3 m^2 area is made of a material whose conductivity is 8.5 W/m-K. The temperature of the wall surface are steady at 100°C and 30°C respectively. Draw the circuit diagram and Calculate.

a. Temperature Gradient

b. Heat flow across the wall in Kilowatts.

(C.O.1) [Application]

Roll No												

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SCHOOL OF ENGINEERING

TEST 2

Winter Semester: 2021 - 22
Course Code: MEC 209
Course Name: Heat and Mass Transfer
Program & Sem: B.Tech. & VI Sem

Date: 31st MAY 2022
Time: 01:30 PM to 02:30 PM
Max Marks: 30
Weightage: 15%

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Use of Non-programmable calculator is allowed.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks. (6Qx 2M= 12M)

1. On heat transfer surface, fins are provided [2M] (C.O.1) [Knowledge]

A. To decrease the rate of heat transfer.

B. To decrease the velocity of air.

C. To increase surface area to promote the rate of heat transfer

D. None of these

2. If heat dissipation for one fin is given by 377.45 k J/hour, then what is the heat dissipation for 12 fins? [2M] (C.O.1) [Knowledge]

A. 7529.4 k J/hour B. 6529.4 k J/hour

C. 5529.4 k J/hour D. 4529.4 k J/hour

3. The value of Biot number is very less(less than 0.1) when. [2M] (C.O.1) [Knowledge]

A. The Conductive resistence of solid first increases and then it becomes constant.

B. The Conductive resistence of fluid is negligible.

C. The Conductive resistence of solid is very large.

D. None of the mentioned

4. For evaporators and condensers, for the given conditions, the logarithmic mean temperature difference (LMTD) for parallel flow is: [2M] (C.O.1) [Knowledge]

A. Equal to that for counter flow B. Greater than that for counter flow

. C. Smaller than that for counter flow D. None of the above

5. In parallel flow heat exchanger both the fluids (hot and cold fluid) flow in opposite direction. (True/False) [2M] (C.O.1) [Knowledge]

6. In Counter flow heat exchanger both the fluids (hot and cold fluid) flow in same direction. (True/False). [2M] (C.O.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries FOUR marks. (2Qx4M=8M)

11. You are designing a car and you want to install a heat exchanger so that maximum heat can be dissipated from the heat exchanger. Which heat exchanger will you choose and why. Mention proper reason with temperature profile for selecting a particular heat exchanger. Assume input of all types of heat exchanger is same. [4M](C.O.1) [Comprehension]

12. Define Fins. Also define effectiveness of fin and write the expression for effectiveness of fins. Assume fin to be of length L and tip insulated. [4M](C.O.1) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries FIVE marks. (2Qx5M=10M)

13. Cold water flowing at 0.1 kg/s is heated from 20°C to 70°C in a counter flow type heat exchange by a hot water stream flowing at 0.1 kg/s and entering at 90°C. The specific heat of water is 4200 J/(kgK) and density is 1000 kg/m3 . If the overall heat transfer coefficient U for the heat exchange is 2000 W/(m2 K),Draw temperature diagram of heat exchanger and find the required heat exchanger area (in m^2). [5M] (C.O.1) [Application]

14. A steel ball of diameter 60 mm is initially in thermal equilibrium at 1030°C in a furnace. It is suddenly removed from the furnace and cooled in ambient air at 30°C, with convective heat transfer coefficient h = 20 W/m²K. The thermophysical properties of steel are: density ρ = 7800 kg/m², conductivity k = 40 W/mK and specific heat c= 600 J/kgK. Find the time required (in seconds) to cool the steel ball in air from 1030°C to 430°C . [5M](C.O.1) [Application]

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM EXAMINATION

Winter Semester: 2021 - 22
Course Code: MEC 209
Course Name: Heat and Mass Transfer
Program & Sem: B.Tech.MECH & VI Sem

Date: 28th June 2022
Time: 9.30 AM to 12.30 PM
Max Marks: 100
Weightage: 50%

Instructions:
(iii) Read the all questions carefully and answer accordingly.
(iv) Use of Non-programmable calculator is allowed.

Part A [Memory Recall Questions]

1. Answer all the Questions. Each question carries TWO marks. (15Qx 2M= 30M)

i. Heat is transferred in through vaccum by means of ..... . (C.O.1) [Knowledge]

A. Conduction B. Convection C. Radiation D. None of these

ii. Which of the following is correct regarding one dimensional heat transfer? . . (C.O.1) [Knowledge]

A. Steady – f (x, y, t), Unsteady – f (x) B. Steady – f (y, z), Unsteady – f (y)
C. Steady – f (x, t), Unsteady – f (x) D. Steady – f (x), Unsteady – f (x, t)

iii. Radiation heat transfer is characterized by (C.O.1) [Knowledge]

A. Movement of discrete packets of energy as electromagnetic waves
B. Due to bulk fluid motion, there is a transport of energy
C. There is the circulation of fluid by buoyancy effects
D. Thermal energy transfer as vibrational energy in the lattice structure of the material

iv. Upto the critical radius of insulation, (C.O.1) [Knowledge]

A. adding insulation will increase heat transfer
B adding insulation will decrease heat transfer
C. adding insulation will first increase and then decrease heat transfer
D. None of above

v. Unit of thermal diffusivity is……. (C.O.1) [Knowledge]

vi. LMTD in case of counter flow heat exchanger as compared to parallel flow heat exchanger is. (C.O.1) [Knowledge]

A. Higher B. Lower C. Same D. Depends on area of heat exchanger

vii. The emissive power of a blackbody is P. If its absolute temperature is doubled, the emissive power becomes (C.O.1) [Knowledge]

A. 2P B. 4P C. 8P D. None

viii. For an opaque surface, the absorptivity (α), transmissivity (τ) and reflectivity (ρ) are related by the equation: (C.O.1) [Knowledge]

A. $\alpha+\rho=\tau$ B. $\alpha+\rho+\tau=0$ C. $\alpha+\rho=1$ D. None

ix. Which of the following is a mode of heat transfer. (C.O.1) [Knowledge]

a) Convection b) Radiation c) Conduction d) All of the mentioned

x. Shape factor of a flat plate with respect to itself is…… . (Assume the radiation from flat surface is from one side) (C.O.1) [Knowledge]

xi. Consider the radiation heat exchange inside an annulus between two very long concentric cylinders. The radius of the outer cylinder is R_O and that of the inner cylinder is R_i. The radiation view factor of the outer cylinder onto itself is…… (C.O.1) [Knowledge]

xii. Saturated steam at 100°C condenses on the outside of a tube. Cold fluid enters the tube at 20°C and exits at 50°C. The value of the Log Mean Temperature Difference (LMTD) is _____

(C.O.1) [Knowledge]

xiii. For a heat exchanger, ΔT_{MAX} is the maximum temperature difference and ΔT_{MIN} is the minimum temperature difference between the two fluids. LMTD is the log mean temperature difference. C_{MIN} and C_{MAX} are the minimum and the maximum heat capacity rates. The maximum possible heat transfer (Q_{MAX}) between the two fluids is (C.O.1) [Knowledge]

A. C_{MIN}.LMTD
B. C_{MIN}. ΔT_{MAX}
C. C_{MAX}. ΔT_{MAX}
D. C_{MAX}. ΔT_{MIN}

xiv. In a heat exchanger, it is observed that ΔT1=ΔT2, where ΔT1 is the temperature difference between the two single phase fluid streams at one end and ΔT2 is the temperature difference at the other end. This heat exchanger is…….. (C.O.1) [Knowledge]

A. a Condenser
B. an evaporator
C. Counter flow heat exchanger
D. Parallel flow heat exchanger

xv. Which one of the following configurations has the highest fin effectiveness?

(C.O.1) [Knowledge]

A. Thin, closely spaced fins
B. Thin, widely spaced fins
C. Thick, closely spaced fins
D. Thick, widely spaced fins

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries FIVE marks. (4Qx5M=20M)

2. Explain effectiveness of heat exchanger with the formula to calculate the effectiveness.
. (C.O.1) [Comprehension]

3. Derive with a neat diagram the Fourier law of Conduction.

(C.O.1) [Comprehension]

4. Define Radiation heat transfer and emissivity. Also state Kirchhoff's law of radiation.

(C.O.1) [Comprehension]

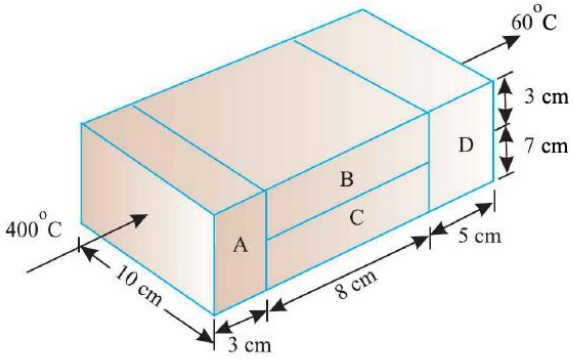
5. Define Irradiation and Radiosity. Write the formula for total number of surface resistances and space resistances when ‘n’ number of radiation shields placed between two surfaces.

(C.O.1) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries TEN marks. (5Qx10M=50M)

6. Find the heat flow rate through the composite wall as shown in the fig. 1. Assume one dimensional heat flow.



$k_A = 150\ W/m°C,$
$k_B = 30\ W/m°C,$
$k_C = 65\ W/m°C,\ and$
$k_D = 50\ W/m°C$

Fig. 1

7. A solid copper sphere of 10 cm diameter, density ρ=8954 kg/m^3, Specific heat C_P =383 J/kg-K, thermal conductivity K = 386 W/m-K, initially at uniform temperature $t_i = 250°C,$ is suddenly immersed in a well-stirred fluid which is maintained at a uniform temperature, $t_a = 50°C$. The heat transfer coefficient between sphere and fluid is h= 200 W/m^2-K. Determine the temperature of copper block at time=300 seconds after the immersion. (C.O.3) [Application]

8. In a concentric counter flow heat exchange, water flows through the inner tube at 25°C and leaves at 42°C. The engine oil enters at 100°C and flows in the annular flow passage. The exit temperature of the engine oil is 50°C. Mass flow rate of water and the engine oil are 1.5 kg/s and 1 kg/s, respectively. The specific heat of water and oil are 4178 J/kg-K and 2130 J/kg-K, respectively. Find the effectiveness of this heat exchanger. (C.O.3) [Application]

9. Define shape factor and explain with proper example.

A solid sphere 1 (as shown in fig 2) of radius 'r' is placed inside a hollow, closed hemispherical surface 2 of radius '4r'. Find the shape factor F_{21}. (C.O.3) [Application]

Fig 2

10. A plate having 10 cm^2 area each side is hanging in the middle of a room of 100 m^2 total surface area. The plate temperature and emissivity are respectively 800 K and 0.6. The temperature and emissivity value for the surfaces of the room are 300 K and 0.3 respectively. Boltzmann's constant σ = 5.67 × 10^{-8} W/m^2K^4 . Find the total heat loss from the two surfaces of the plate.

(C.O.3) [Application]