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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JAN 2023

Semester : Semester V - 2020

Course Code : PET2008

Course Name : Sem V - PET2008 - Heat and Mass Transfer for Petroleum Engineering

Program : B.Tech. Petroleum Engineering

Date : 9-JAN-2023

Time : 9.30AM - 12.30PM

Max Marks : 60

Weightage : 30%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.

PART-A

ANSWER ALL THE FOLLOWING QUESTIONS **5Q X 2M = 10M**

1. Define convection. State one example.

(CO1) [Knowledge]

2. State general heat conduction equation for cylindrical co-ordinate.

(CO1) [Knowledge]

3. Define Emissive power. State its unit.

(CO2) [Knowledge]

4. Define convective mass transfer with an example.

(CO3) [Knowledge]

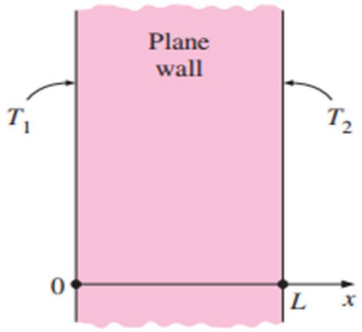
5. Define flux. State its SI unit.

(CO3) [Knowledge]

PART-B

ANSWER ALL THE FOLLOWING QUESTIONS **3Q X 10M = 30M**

6. (a) A large plane wall of thickness L = 0.2 m, thermal conductivity k = 1.2 W/m·°C, convective heat transfer coefficient of air surrounding this wall, h = 30 W/m^2·°C and surface area A = 15 m^2. The two sides of the wall are maintained at constant temperatures of T_1=120°C and T_2 = 50°C, respectively, as shown in Figure. Identify the mode of heat transfer and obtain an expression for the temperature profile within the wall.



(b) A metal rod 0.4 m long & 0.04 m in diameter has one end at 373 K & another end at 273 K. Estimate the total amount of heat conducted in 1 minute. (Given K = 385 J / m s °C)

(CO1) [Comprehension]

7. (a) You are a drilling engineer posted on a site very away from the main city. You used to go to work and take your lunch wrapped in aluminum foil. As you all know aluminum foil has two surfaces (viz., one is smooth and the other rough). Identify the surface you will use to wrap your lunch so that it stays hot. Justify your answers.

(b) Elucidate the concept of thermal boundary layer and boundary layer thickness.

(CO2) [Comprehension]

8. (a) The following equation describes molecular mass transfer:

$J_{Az} = -D_{AB}\frac{dC_A}{dz}$, where symbols have the usual meanings. (i) Identify the law which governs this equation;
(ii) Explain the law with proper assumptions.

(b) This can be deduced from the salt-water experiment that convective mass transfer is faster than conductive mass transfer. Justify the statement.

(CO3) [Comprehension]

PART-C

ANSWER THE FOLLOWING QUESTION **1Q X 20M = 20M**

9. (a) Consider a 20 cm diameter spherical ball at 800 K suspended in the air. Assuming the ball closely appropriates a black body (σ = 5.67 x 10 $^{-8}$ W/m^2K^4). Determine (i) the total emissive power (ii) the total amount of radiation emitted by the ball in 5 min.

(b) Hot air at 66 °C is cooled up to 38 °C by means of cold air at 15.5 °C. Mass flow rates of hot and cold air are 1.25 kg/s and 1.6kg/s respectively. The specific heat of hot and cold air is 1.05 KJ/kg.K and overall heat transfer coefficient (U) is 80 W/m^2K. Assume it is a parallel flow heat exchanger. Calculate (i) the LMTD (ii) the area of the heat exchanger for parallel flow configuration

(CO2) [Application]

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