ROLL NO:	

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY, BENGALURU

SCHOOL OF ENGINEERING

Weightage: 20 % Max Marks: 40 Max Time: 1 hr. Monday, 24th September, 2018

TEST – 1

Odd Semester 2018-19 Course: **MEC 209 Heat and Mass transfer** V Sem. Mechanical

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Instruction:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A

(3 Q x 4 M = 12 Marks)

1. Define Heat Transfer. Explain the modes of heat transfer.
2. Explain significance of Biot number and Fourier number with their respective mathematical formulations.
3. Explain briefly:
   a) Thermal Conductivity
   b) Thermal diffusivity
   c) Overall heat Transfer Co- efficient
   d) Thermal contact Resistance

Part B

(2 Q x 8 M = 16 Marks)

4. Starting from fundamental principles develop general 3-dimensional heat conduction equation in Cartesian co-ordinates

5. An insulated steam pipe having outside diameter of 30mm is to be covered with two layers of insulation each having thickness of 20mm. The thermal conductivity of one material is 5 times that of the other. Assuming that the inner and outer surface better temperatures of composite insulation are fixed, how much will heat transfer be increased when insulation material is next to the pipe than it is outer layer.

Part C

(1Q x 12 M = 12 Marks)

6.

a) A 50 x 50 cm copper slab 6.25mm thick has a uniform temperature of 300°C. Its temperature is suddenly lowered to 36°C. Calculate the time required for the plate to reach the temperature of 108°C. Take ρ = 9000kg/m^3, C = 0.38 kJ/kg^{0}C, k = 370 W/m^{0}C and h = 90 W/m^{0}C.

b) It is required to heat oil to about 300°c for frying purpose. A laddle is used in the frying. The section of the handle 5mm*18mm. The surrounding are at 30°c. The conductivity of the material is 205 W/m^{0}c. If the temperature at a distance of 380mm from the oil should not reach 40°c, determine the convective heat transfer coefficient.

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TEST 2

Odd Semester: 2018-19 | **Date**: 27 November 2018

Course Code: MEC 209 | **Time**: 1 Hour

Course Name: Heat and Mass Transfer | **Max Marks**: 40

Branch & Sem: MEC & V Sem | **Weightage**: 20%

Instructions:

(i) Question paper consists of 3 parts
(ii) In Part C answer any one question. In Part A and Part B all questions are mandatory.
(iii) Scientific and non-programmable calculators are permitted.
(iv) Heat and Mass Transfer Data Hand Book is permitted.

Part A

Answer **all** the Questions. **Each** question carries **four** marks. (3x4=12)

1. With the help of neat sketch explain velocity boundary layer for fluid flowing over a flat plate.
2. Define and explain the physical significance of (i) Nusselt Number (ii) Grashoff's Number
3. Explain the following in detail:
   a) Momentum thickness
   b) Energy Thickness

Part B

Answer **all** the Questions. **Each** question carries **eight** marks. (2x8=16)

4. A cylindrical body of 300mm diameter and 1.6m height is maintained at a constant temperature of 36.5°C. The surrounding temperature is 13.5°C. Find out the amount of heat to be generated by the body per hour by using following data:
ρ = 1.025 kg/m^3, C_p = 0.96 KJ/Kg°C, μ = 15.43*10^{-6} m^2/s, K = 0.0892 kj/m-h-°c and β = 1/298 k^{-1}. Assume Nu = 0.12(Gr. Pr)$^{1/3}$.

5. Sketch and explain various regimes of pool boiling curve for water

Part C

Answer any **one** Question. Each question carries **twelve** marks. (1x12=12)

6. Water is boiled at the rate of 25 kg/h in a copper pan, 280mm in diameter, at atmospheric pressure. Assuming nucleate boiling conditions, calculate the temperature of the bottom surface of the pan. T_{sat} =100°C, ρ_l =958.4 kg/m^3, ρ_v = 0.5955 kg/m^3, Cp_l = 4220 J/kg K, μ_l = 279 x 10^{-6}, Pr_l = 1.75, h_{fg} =2257 kJ/kg, σ = 58.9 x 10^{-3} N/m, n =1 (for water)

7. Air at 20°C and a pressure of 1 bar is flowing over a plate at a velocity of 3m/s. If the plate is 280mm wide and at 56°C, calculate the following quantities at x = 280mm. Extract the various properties of air at bulk mean temperature.
   i) Boundary layer thickness, (ii) Local Skin friction co efficient, (iii) Average friction co efficient, (iv) Shearing stress due to friction, (v) Thickness of boundary layer, (vi) Local Convective heat transfer co efficient, (vii) Average convective heat transfer co efficient, (viii) Rate of heat transfer by convection, (ix) Rate of heat transfer by convection, (ix) Total drag force on the plate, (x) Total mass flow rate.

Roll No.												

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END TERM FINAL EXAMINATION

Odd Semester: 2018-19 | **Date**: 26 December 2018

Course Code: MEC 209 | **Time**: 2 Hours

Course Name: Heat and Mass Transfer | **Max Marks**: 80

Programme & Sem: MECH & V Sem | **Weightage**: 40%

Instructions:

(i) ***Heat and Mass transfer data book is permitted.***

Part A

Answer **all** the Questions. **Each** question carries **four** marks. (5Qx4M=20)

1. Classify the heat exchanger. Draw the temperature profile of double pipe heat exchanger in parallel and counter mode.
2. Define the effectiveness of heat exchanger. What is the use of fouling factor in designing the heat exchanger?
3. Explain the concept of a black body.
4. Define the following:
   a. Stefan-Boltzmann Law
   b. Wien's Displacement Law
5. Define the shape factor. Mention its salient features.

Part B

Answer **all** the Questions. **Each** question carries **ten** marks. (3Qx10M=30)

6. Derive the relation to calculate the LMTD of heat exchanger in parallel flow mode. Define all the notations used in the derivation.
7. a. What is a radiation shield?
   b. What is the Reciprocity Theorem?
   c. Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2500°C:
   I. Monochromatic emissive power at 1.2 μm length;
   II. Wavelength at which the emission is maximum;
   III. Maximum emissive power;
   IV. Total emissive power
8. Derive the relation to prove the total emissive power of a diffuse surface is equal to π times its intensity of radiation.

Part C

Answer **all** the Questions. **Each** question carries **fifteen** marks. (2Qx15M=30)

9. A counter flow heat exchanger with tube dia of 30mm is employed with the 0.8 kg/s (C_p = 2.45 kJ/kg.K) of oil from 150°C to 50°C by the use of water. The inlet and exit temperatures of water are 20°C and 80°C respectively. The overall heat transfer coefficient is 1450 W/m^2.°C. Using LMTD method, calculate;
    a. The mass flow rate of water,
    b. Effectiveness of heat exchanger,
    c. Length of heat exchanger

10. In a shell and tube type of condenser, steam condenses at 0.4 bar pressure on the external surface of the tubes. The cooling water flowing at the rate of 3600 kg/h, enters the tube at 25°C and leaves at 50°C. Calculate the following :
    a. The rate of condensation of steam in kg/h
    b. The overall hat transfer coefficient based on inner surface of the condenser,
    c. Number of transfer units NTU, and
    d. The effectiveness of the condenser.
    e. Assume latent heat of steam – 2319 kJ/kg; specific heat of water – 4187 kJ/kg; tube length – 10 m; diameter of tube – 25 mm; number of tubes – 10.