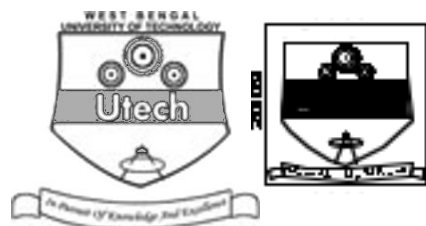


HEAT TRANSFER AND COMBUSTION (SEMESTER - 4)

CS/B.Tech (AUE-N)/SEM-4/AUE-402/09



1.
Signature of Invigilator

2.
Signature of the Officer-in-Charge

Reg. No.

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Roll No. of the Candidate

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CS/B.Tech (AUE-N)/SEM-4/AUE-402/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

HEAT TRANSFER AND COMBUSTION (SEMESTER - 4)

Time : 3 Hours]

[Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

- This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
- In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
 - For **Groups – B & C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
- Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
- Read the instructions given inside carefully before answering.
- You should not forget to write the corresponding question numbers while answering.
- Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
- Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
- You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
- Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

Group – A								Group – B				Group – C				Total Marks	Examiner's Signature
Question Number																	
Marks Obtained																	

.....
Head-Examiner / Co-Ordinator / Scrutineer

4483 (08/06)



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ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
HEAT TRANSFER AND COMBUSTION
SEMESTER - 4



Time : 3 Hours]

[Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

10 × 1 = 10

i) The concept of log mean area is normally used in the analysis of

- a) composite plane surface b) cylindrical surface
c) spherical surface d) any plane surface.

ii) Upto the critical radius of insulation

- a) convective heat loss will be less than the conduction heat loss
b) heat flux will decrease
c) added insulation will decrease heat loss
d) added insulation will increase heat loss.

iii) Thermal diffusivity is

- a) a physical property of material
b) a mathematical entity
c) a configuration for heat conduction
d) a dimensionless parameter.



4

iv) A fin will be effective only when Biot no. is

a) less than one

b) more than one

c) equal to one

d) infinite.

v) The unit of which of the following parameters is not m^2 / s ?

a) Thermal diffusivity

b) Kinematic viscosity

c) Dynamic viscosity

d) Mass diffusivity.

vi) A non-dimensional number generally associated with natural convection is

a) Grashof number

b) Nusselt number

c) Weber number

d) Prandtl number.

vii) LMDT in case of counter-flow as compared to parallel flow heat exchanger is

a) higher

b) lower

c) same

d) dependent on temp. distribution.

viii) A grey body is one for which emissivity is equal to

a) reflectivity

b) absorptivity

c) constant

d) transmissivity.



5

ix) The wavelength for maximum emissive power is given by

a) Kirchhoff's law

b) Stefan-Boltzmann law

c) Fourier's law

d) Wien's law.



x) Nusselt number is given by

a) $\mu C_p / k$ b) $\mu k / C_p$ c) hL / k d) hk / L .
GROUP – B**(Short Answer Type Questions)**Answer any *three* of the following.

3 × 5 = 15

2. a) What is thermal diffusivity ? What are its physical significance ? 3
- b) Explain the term 'geometric mean area' as applied to a sphere. 2
3. Consider a slab of thickness L in which the heat is generated at a constant rate of $q_0 \text{ W/m}^3$. The boundary surfaces at $x = 0$ and $x = L$ are maintained at T_1 and T_2 respectively. Develop an expression for the heat flux $q(x)$ and temp. $T(x)$ at any section of the slab. 5
4. What is shape factor ? Write the various features of shape factor. 5
5. Define the following : 5
- i) Opaque body
- ii) White body
- iii) Black body
- iv) Grey body.
6. State Newton law of cooling and write the factors on which the value of 'h' depends. 5



6
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.



$3 \times 15 = 45$

7. a) The cross-sectional area of a long prismatic fin is A . The conductivity of the fin material is k and the temp. at the base of the fin is T_o . The fin is exposed to air whose temp. is T_a . If the heat transfer coefficient at the surface of the fin is h , derive expression for temperature distribution and the heat dissipation rate of the fin. 9
- b) One end of a very long aluminium rod is connected to a wall at 140°C while the other end protrudes into a room whose air temp. is 15°C . The diameter of the rod is 3mm and the thermal conductivity of the rod material is 150 W/mK . If the heat transfer co-efficient between the rod surface and environment is $300 \text{ W/m}^2 \text{ K}$, determine the heat dissipation rate of the fin. 6
8. a) Explain the term 'critical radius of insulation'.
- b) Starting from the first principle derive an expression for critical radius of insulation for the case of a cylinder. 4
- c) An electrical conductor of copper ($k = 400 \text{ W/mK}$) with 1 mm diameter is covered with plastic insulation ($k = 0.5 \text{ W/mK}$) of thickness 1 mm. The temperature of its surroundings is 20°C . Find the maximum current that can be carried by the conductor so that no part of the plastic is above 80°C . Assume that the film heat transfer coefficient is $8 \text{ W/m}^2 \text{ K}$ and the specific electric resistance of the copper is $8 \text{ W/m}^2 \text{ K}$. 9



7

9. a) Derive an expression for the shape factor in case of radiation heat exchange between two black bodies and prove that $F_{1-2} A_1 = F_{2-1} A_2$ 10
- b) Define Irradiation and Radiosity. 5
10. a) Derive an expression for log mean temperature difference (LMTD) in case of parallel flow heat exchanger. 8
- b) In a parallel flow heat exchanger hot water flows at a rate of 5000 kg/hr and gets cooled from 95°C to 65°C. At the same time 50,000 kg/hr of cooling water at 30°C enters the heat exchanger. Overall heat transfer coefficient is 2270 W/m² K. Determine area required for the heat exchanger and the effectiveness of the heat exchanger. Take C_p for both the fluid as 4.2 kJ/kg-K. 7
11. a) Define natural and forced convections. Discuss physical significance of the following dimensionless numbers : 8
- $R_e , N_u , P_r .$
- b) Describe Orsat apparatus and write briefly how the combustion products are analyzed by it. 7

END