	Utech
Name:	
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Invigilator's Signature :	

CS/B.Tech (AUE)/SEM-4/AUE-402/2011 2011

HEAT TRANSFER AND COMBUSTION

Time Allotted: 3 Hours Full Marks: 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

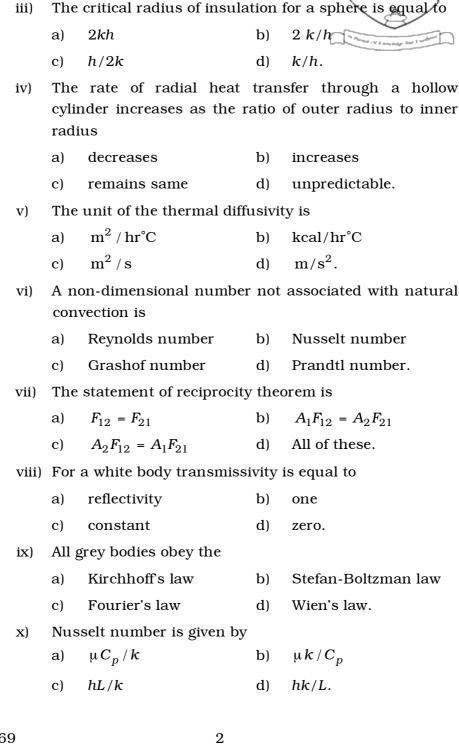
GROUP - A

(Multiple Choice Type Questions)

- 1. Choose the correct alternatives for the following: $10 \times 1 = 10$
 - LMDT in case of parallel flow as compared to counteri) flow heat exchanger is
 - higher a)
 - lower b)
 - c) same
 - d) dependent on temperature distribution.
 - A composite plane wall is made of two different ii) materials of same thickness with thermal conductivities k_1 and k_2 . The equivalent thermal conductivity of the slab is
 - a) $k_1 + k_2$
- b) $k_1 k_2$
- c) $(k_1 + k_2)/k_1 k_2$ d) $2k_1 k_2/(k_1 + k_2)$.

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GROUP - B

(Short Answer Type Questions)

Answer any three of the following.



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- 2. Derive an expression for heat flow in radial direction for a hollow cylinder (inside radius r_i and outside radius r_o) of length L and uniform thermal conductivity k under steady state and without any heat generation. The inner and outer surface temperatures of the cylinder are T_i and T_o respectively.
- 3. Calculate overall heat transfer coefficient of a cylinder when heat is flowing from inside to outside direction.
- 4. What is shape factor? Write the various features of shape factor.
- 5. What do you mean by logarithmic mean area and geometric mean area?
- 6. a) Explain the term 'critical radius of insulation'.
 - b) Derive an expression for critical radius of insulation for the case of sphere.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

- 7. a) Derive the general three dimensional differential equation of heat conduction with internal heat generation for a rectangular coordinate system. 8
 - b) A wall of 0·5 m thickness is to be constructed from a material which has an average thermal conductivity of 1·4 W/mK. The wall is to be insulated with a material having an average thermal conductivity of 0·35 W/mK so that the heat loss per square metre will not exceed 1450 W. Assume that the inner and outer surface temperatures are 1200° C and 15° C respectively. Calculate the thickness of insulation required. 7

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- 8. a) Derive an expression for heat flow in radial direction and maximum temperature for a solid sphere of radius R and, uniform thermal conductivity k under steady state and with internal heat generation q/unit volume. The outer surface temperature of the cylinder is T_w and atmospheric temperature is T_q .
 - b) A hollow sphere with ID 10 cm is made up of two materials; first with steel (k = 70 W/mK) and second with iron (k = 15 W/mK). Steel layer is 10 cm thick and iron layer is 5 cm thick. The inside and outside surface temperatures are 300° C and 30° C respectively. Calculate the rate of heat flow and temperature between two layers.
- 9. a) Derive an expression for heat flow in a very long fin. 8
 - b) One end of a very long steel rod is maintained at 1400° C while the other end is into a fluid with temperature 15° C. The diameter of the rod is 3 mm and the thermal conductivity of the rod material is 240 W/mK. If the heat transfer co-efficient between the rod surface and fluid is $400 \text{ W/m}^2\text{K}$, determine the heat dissipation rate of the fin.
- 10. a) Derive an expression for log mean temperature difference (LMTD) in case of parallel flow heat exchanger.
 - b) Hot oil with a capacity rate of 2500 W/K flows through a double pipe heat exchanger. It enters at 360° C and leaves at 300° C. Cold fluid enters at 30° C and leaves at 200° C. If the overall heat transfer coefficient is $800 \ \text{W/m}^2 \text{K}$, determine the heat exchanger area required for
 - i) parallel flow
 - ii) counter flow.

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- 11. a) What is intensity of radiation? Prove that total emissive power of a diffuse surface is equal to π times its intensity of radiation.
 - b) What is the difference between natural convection and forced convection?

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