KERALA AGRICULTURAL UNIVERSITY
B. Tech. (Agrl. Engg.) 2023 & Previous Admissions
IV Semester Final Examination – June 2025

Fape.2203 **Heat and Mass Transfer (2+0)** **Marks: 50**
Time: 2 hours

I **Fill in the blanks** **(10x1=10)**

1. Particles of a substance ..... at their place in conduction.
2. Mach number is the ratio of ..... to .....
3. ..... do not require any medium for heat transfer.
4. The relation, Sc = Pr = 1, is valid, when the mechanism of ..... is same.
5. The hotness of an object is determined by its .....

State True or False

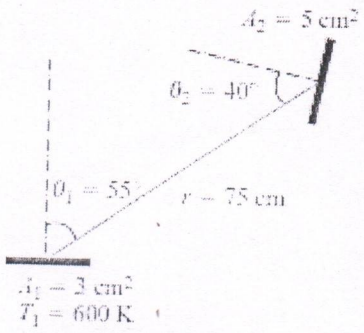
6. The specific heats of a substance for an ideal gas depend on temperature and pressure.
7. Copper is a better conductor of heat than iron.
8. Viscosity of air decreases with increase in temperature.
9. The unit of Reynolds number is W/m.K.

Define

10. Fick's law of diffusion.

II **Write short notes on ANY FIVE of the following** **(5x2=10)**

1. Science of thermodynamics differs from science of heat transfer. How?
2. Define Fouling factor.
3. Define conduction and radiation.
4. Define view factor, radiosity, spectral transmissivity.
5. A small surface of area (A_1) 3 cm^2 emits radiation as a blackbody at Temperature 600 K. Part of the radiation emitted by A_1 strikes another small surface of area (A_2) 5 cm^2 oriented as shown in Figure below Determine the solid angle subtended by A_2 when viewed from A_1, and the rate at which radiation emitted by A_1 that strikes A_2



6. What are parallel flow and counter flow heat exchangers?
7. Draw a schematic showing various boundary layers and zones when a fluid is flowing over a flat plate.

III **Answer ANY FIVE of the following** **(5x4=20)**

1. A plane wall is subjected to 80°C temperature with an area of $20m^2$ on the one side of the wall and convection on the other side with ambient temperature as 15°C and heat transfer coefficient as $24W/m^2$ K. Consider the thickness of the wall as 40cm. Calculate the rate of heat transfer assuming 1-d steady state heat transfer. Take thermal conductivity of wall as 2.3 W/m K. Assume no heat generation.
2. Summerize Reynold's Analogy.
3. A fluid enters a pipe of diameter 46mm and length of 15000mm at 363K with a velocity of 0.8m/s. The ambient temperature is 283K. Calculate the total heat loss taking place from the pipe. Assume heat transfer coefficient as 15 W/m^2.K.
4. An isothermal cube with temperature 727°C and side 200mm is suspended in air. Determine
   (a) the rate at which cube emits radiation and
   (b) the spectral blackbody emissive power
   Assume the wavelength as 4μm.
5. Explain the significance of critical radius of insulation.
6. The inlet and outlet temperatures of water are 293K and 328K and for oil it is 393K and 418K respectively. The mass flow rate of both the fluids are 5000g/s. Calculate the overall heat transfer coefficient. Assume tube side diameter as 1.2cm and length as 200cm. Take specific heat of water as 4.18 kJ/kg K and oil as 2.15 kJ/kg K.
7. Define bulk fluid flow and what are various diffusion processes. Give examples.

IV **Write an essay on ANY ONE of the following** **(1x10=10)**

1. Explain Fourier's Law. Derive the three dimensional fourier conduction equation.
2. Write essay on heat exchangers.

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