Graphic Era
HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

End Term (Odd) Semester Examination November 2025

Roll no.....

Name of the Course and semester: B Tech ME, V sem
Name of the Paper: Heat Transfer
Paper Code: TME 501

Time: 3 hour

Maximum Marks: 100

Note:

(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks) CO1

a. State and explain Fourier's law of heat conduction. Derive the one-dimensional conduction equation in cylindrical coordinates.

b. Define thermal conductivity and overall heat transfer coefficient with suitable units.

c. A hollow sphere of inner radius 20 mm and outer radius 40 mm is made of steel (k = 45 W/mK). Inner and outer surface temperatures are 200°C and 50°C respectively. Calculate the heat flow per m^2.

Q2. (2X10=20 Marks) CO2

a. Explain the effect of fin length and material on fin efficiency and effectiveness.

b. Derive the temperature distribution and heat flow equation for a fin with convective tip.

c. A steel fin (k=54 W/mK) 5 mm thick, 10 cm long, and 5 cm wide is attached to a wall at 150°C with air at 25°C (h=45 W/m^2K). Calculate fin efficiency and effectiveness.

Q3. (2X10=20 Marks) CO3

a. Discuss the dimensionless numbers used in forced convection and explain their physical significance.

b. Explain Reynold's analogy between momentum and heat transfer.

C. Discuss the mechanism of free convection heat transfer over vertical and horizontal plates and mention important governing parameters.

Q4. (2X10=20 Marks) CO4

a. Define emissivity, absorptivity, and reflectivity. Explain Lambert's cosine law..

b. Derive the radiation exchange equation between two infinite gray parallel plates.

c. Calculate the net radiation heat exchange between two 1 m^2 parallel plates (T_1 = 600 K, T_2 = 400 K, $\varepsilon_1 = \varepsilon_2$ = 0.8).

Q5. (2X10=20 Marks) CO5

a. Classify different types of heat exchangers and mention their applications..

b. Derive the relation between NTU and Effectiveness for a parallel flow heat exchanger..

c. Explain various modes of boiling and condensation with neat sketches.