

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur (GIET University)



B. Tech (Sixth Semester - Regular) Examinations, April 2026

23BMEPC36001– Heat Transfer

(Mechanical Engineering)

Time: 3 hrs

Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A

(2 x 5 = 10 Marks)

Q.1. Answer **ALL** questions

	CO #	Blooms Level
a. Differentiate between conduction and convection (any two points).	CO1	K2
b. What is the analogy between electrical circuit and thermal circuit? Write S.I Unit of thermal resistance.	CO1	K2
c. Under what condition is a fin considered infinitely long?	CO2	K2
d. What is the difference between a black body and gray body?	CO4	K2
e. What is meant by effectiveness of a heat exchanger?	CO5	K1

PART – B

(10 x 5 = 50 Marks)

Answer **ALL** the questions

	Marks	CO #	Blooms Level
2. a. Derive heat flow through a composite wall.	5	CO1	K1
b. A composite wall has two layers: Layer1 has conductivity (k_1) is 0.5 W/m·K, and thickness of 0.1m and Layer2 has conductivity (k_2) is 1.5W/m·K, thickness is 0.2 m. If the temperature difference is 100°C, find heat transfer rate per unit area.	5	CO1	K1
(OR)			
c. Explain fin efficiency and fin effectiveness.	5	CO2	K2
d. An egg with mean diameter of 40mm and initially at 20°C is placed in boiling water pan for 4minutes and found to be 4 minutes and found to be boiled to consumer's taste. For how long should be similar egg for same consumer be boiled when taken from a refrigerator at 5°C. Assume $k= 10\text{W/m K}$, $\rho=1200\text{kg/m}^3$, $c=2\text{KJ/kgK}$ and surface conductance= $100\text{W/m}^2\text{C}$.	5	CO2	K3
3.a. What do you mean by characteristics length or Equivalent diameter? Write its significance?	5	CO2	K2
b. The velocity distribution in the boundary layer is $u/U=Y/\delta$, where u is the velocity at a distance y from the plate and $u=U$ at $y=\delta$, δ being boundary layer thickness. Find displacement thickness.	5	CO3	K3
(OR)			
c. Explain various regimes of saturated pool boiling.	5	CO5	K2
d. Differentiate between the mechanism of film wise and dropwise condensation.	5	CO5	K2
4.a. Derive the expression for logarithmic mean temperature difference for counter flow heat exchanger.	5	CO5	K4
b. Why are black surfaces better emitters? How black body is different from the opaque body?	5	CO4	K2

(OR)

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|------|---|---|-----|----|
| c. | Define view factor in radiation. Determine shape factor of a black body inside a black enclosure. | 5 | CO4 | K3 |
| d. | What do you mean by radiation shield? | 5 | CO4 | K1 |
| 5.a. | What do you mean by local heat transfer coefficient?
A vertical plate of height 0.35 m and length 1.2 m is maintained at 80°C and exposed to air at 30°C. Find the average heat transfer coefficient.
$\bar{h} = k/L[0.67(Pr)^{1/4}(0.952 + Pr)^{-1/4}(Gr)^{1/4}]$ | 5 | CO3 | K3 |
| b. | Differentiate between forced convection and natural convection.
(OR) | 5 | CO3 | K2 |
| c. | Draw the thermal resistance network for a composite wall | 5 | CO1 | K2 |
| d. | A pipe is insulated with material of conductivity $k=0.05 \text{ W/m}\cdot\text{K}$ Heat transfer coefficient $h=10 \text{ W/m}^2\text{K}$ Find critical radius of insulation. | 5 | CO2 | K3 |
| 6.a. | Write the general heat conduction equation in Cartesian coordinates and reduce it to Laplace equation. | 5 | CO2 | K4 |
| b. | What do you mean by effectiveness of heat exchanger?
A counter flow heat exchanger is used to heat water from 20°C to 80°C by using hot exhaust gas entering at 140 °C and leaving at 80°C Find LMTD for heat exchanger.
(OR) | 5 | CO5 | K3 |
| c. | Derive the general energy equation for 1D heat dissipation from an extended surface. | 5 | CO2 | K4 |
| d. | Calculate the amount of heat energy required to solder together two very long pieces of pure copper wire 1.5 mm in diameter with solder that melts at 190°C. The wires are positioned vertically in air at 20°C. Take $h=20 \text{ W/m}^2\text{K}$ and $k=330 \text{ W/m}\cdot\text{K}$ | 5 | CO2 | K3 |

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