Seat No.:		Q. Paper Code: FTC-A-005	SET	A

Fabtech Technical Campus, College of Engineering & Research, Sangola

(An Autonomous Institute)

Mechanical Engineering

Academic Year: -2025-26, Semester-I

Advanced Engineering Thermodynamics and Heat Transfer (25PME11171)

Regular End Semester Examination Winter 2025-26 [Dec./Jan]

Class:	F. Y. M. Tech.	**Day & Date:**	Thursday, 01/01/2026
Duration:	03 Hrs.	**Max. Marks:**	60 Marks
Time:	11:00 AM TO 02:00 PM		

Instructions:

1) All Questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat diagram wherever necessary.
4) Make suitable assumptions if necessary and state it clearly.
5) Use of non-programmable calculator is allowed.

Q. No.	Questions	Marks	CO	BL
Q. 1	**Attempt any two of the following**	**12**		
1	Explain thermodynamic systems, properties, and equilibrium conditions.	6	1	L2
2	State and explain the First Law and Second Law of thermodynamics in advanced form.	6	1	L2
3	Explain thermodynamic systems, properties, and equilibrium conditions.	**6**	1	L2
Q. 2	**Attempt any two of the following**	**12**		
1	Define activity and discuss its use in phase equilibrium.	6	2	L2
2	Discuss deviations from ideal gas behavior using P-v-T diagrams.	6	2	L2
3	Write and explain the Van der Waals equation and its limitations.	6	2	L2
Q. 3	**Attempt any two of the following**	**12**		
1	Derive steady-state heat conduction with without heat generation in a plane wall.	6	3	L3
2	A solid sphere 5 cm in diameter and initially at 500°C is quenched in a controlled environment at 90°C with convective heat transfer coefficient of 115 W/m^2K. Determine the time taken by centre of the sphere to reach a temperature of 150°C. Use the properties of the solid sphere as; Cp, Sp. heat = 418 J/kgK; ρ, density = 7500 kg/m^3, k, conductivity = 45W/mK.	6	3	L3
3	Discuss the Heisler charts and their applications in unsteady heat transfer.	6	3	L4
Q. 4	**Attempt any two of the following**	**12**		
1	Derive the governing equations of natural convection.	6	4	L3

2	A hot rectangular plate 5 cm X 3 cm maintained at 200 °C is exposed to still air at 30 °C. Calculate percentage increase in convective heat transfer rate if smaller side of the plate is held vertical than the bigger side. Neglect ITG of the thickness. Use Correlation $Nu=0.59\ (Gr.Pr)^{0.25}$	6	4	L4
3	Define the following dimensionless numbers and state their physical significance: (a) Nusselt number (Nu) (b) Reynolds number (Re) (c) Prandtl number (Pr) (d) Grashhof number (Gr)	6	4	L2
Q. 5	**Attempt any two of the following**	**12**		
1	Explain the enclosure method for calculating radiation exchange between multiple surfaces. Solve for net radiation heat flux in a simple two-surface enclosure.	6	5	L3
2	Calculate the net radiant heat exchange per m^2 area for two large parallel plates at temperatures of 427° C and 27° C respectively. ε (hot plate) = 0.9 and ε (cold plate) = 0.6. If a polished aluminium [shield ε (shield) = 0.4 both side.] is placed between them, find the percentage reduction in the heat transfer.	6	5	L3
3	Explain radiation in participating media. How do absorption, emission, and scattering affect radiative heat transfer in gases?	6	5	L2