School of Engineering and Applied Science (SEAS), Ahmedabad University

Name: _____ Roll no.: _____

Ph.D. (Chemical Engineering)
CHE509 Advanced Thermodynamics and Reaction Engineering: Mid Term Exam
Winter 2026); Marks: 30M, Wt.:30%
February 25, 2026, Wednesday, 2:00 PM – 3:30 PM

Instructions:

1 All sections are compulsory.
2 Figures to right indicate full marks.
3 All acronyms carry their usual meaning.
4 Assume suitable data wherever necessary and specify it clearly in your answers.

1. Explain why heterogeneous catalysts are generally porous. How does pore structure influence catalytic activity? **02**

2. Differentiate between Langmuir adsorption assumptions and real adsorption behaviour. **02**

3. Define catalyst selectivity and explain how it can be improved in practice. **02**

4. Why is it necessary to eliminate transport limitations before determining intrinsic kinetics? Explain briefly. **03**

5. Suggest two experimental methods to verify whether external mass transfer resistance is negligible. **03**

6. Define mass transfer coefficient and explain its role in catalytic reactors. **03**

7. A catalyst loses activity during operation due to fouling. Define catalyst deactivation and briefly explain any two mechanisms of catalyst deactivation. How does deactivation affect reactor performance? **03**

8. A first-order reaction occurs in a spherical catalyst pellet of radius R. The effectiveness factor is measured as $\eta=0.45$.
   a) What does this value indicate about diffusion limitations? **02**
   b) State whether the Thiele modulus is likely to be small or large. Justify. **02**
   c) Suggest two methods to increase effectiveness factor. **02**

9. Experimental data for a catalytic reaction are given:

C_A (*mol/L*)	$-r_A$ (*mol/L·s*)
0.15	0.045
0.30	0.180
0.45	0.405

   a) Determine the reaction order with respect to A. **03**
   b) Calculate the rate constant and write the rate expression. **03**
