

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 6 – EXAMINATION – SUMMER 2026

Subject Code: 3164402

Date: 22/05/2026

Subject Name: Chemical Reaction Engineering - II

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions:

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**
- 4. Simple and non-programmable scientific calculators are allowed.**

- Q.1**
- (a) List out the factors required to formulate contacting patterns. **03**
 - (b) Explain the contacting patterns for two-phase systems. **04**
 - (c) Evaluate the rate controlling step of an elementary reaction **07**
$$A(g) + B(s) \rightarrow R(g)$$

- Q.2**
- (a) Write down the limitations of Shrinking Core Model. **03**
 - (b) Differentiate between fixed bed reactor and fluidized bed reactor. **04**
 - (c) Derive the expression for fractional conversion for the reaction between solid and fluid when particles of solid are changing in size and Diffusion through Gas film controls. **07**

OR

- Q.2**
- (c) Draw the sketches for Various ways of studying the flow pattern in vessels. **07**
- Q.3**
- (a) Define activity and selectivity of catalyst. **03**
 - (b) Write a short note on classification and preparation of catalyst **04**
 - (c) Derive the performance equation for plug flow reactor containing porous catalysts. **07**

OR

- Q.3**
- (a) State Henry's law with its application **03**
 - (b) Describe Progressive Conversion Model (PCM) with appropriate diagram. **04**
 - (c) Describe the working principle, merits and demerits of slurry reactor with a neat sketch. **07**

- Q.4**
- (a) Give significance of Thiele Modulus and Effectiveness factor **03**
 - (b) Write short note on catalyst promoters, inhibitors and poisons. **04**
 - (c) For a diffusion through Ash layer control, derive expression for relation for time required for unreacted core model for spherical particles of unchanging size. Also find time required for complete conversion. **07**

OR

- Q.4**
- (a) Define homogeneous and heterogeneous reactions with examples. **03**
 - (b) Discuss steps involved in catalytic reaction with neat sketch. **04**
 - (c) Derive LHHW (Langmuir-Hinshelwood-Hougen-Watson) model with surface reaction as the rate controlling mechanism for the reaction. **07**

- Q.5** (a) Describe the phenomenon of ash-layer diffusion in G/S non-catalytic reactions. Give three examples of industrial G/S non-catalytic reactions. **03**
- (b) State and discuss significance of Hatta modulus in fluid – fluid reaction. **04**
- (c) Write in detail about product distribution in multiple reactions. **07**

OR

- Q.5** (a) Write a short note on trickle bed reactor. **03**
- (b) A feed consisting of 20% of 1 mm particles, 30% of 2 mm particles and 50% of 4 mm particles passes through a rotating tubular reactor (resembling a cement kiln) where it reacts with gas to yield a hard non- friable solid product according to the shrinking– core model (SCM) with chemical reaction controlling. The time required for complete conversion of 4 mm particles (?) is 4 h. Determine the mean conversion of the solids for a residence time of 15 min. **04**
- (c) On doubling the particle size from R to 2R the time needed for complete conversion of a particle triples. Determine the contribution of ash diffusion to the overall resistance for particles of size (i) R and (ii) 2R. Neglect the gas film resistance. **07**
