Format K1

Maharashtra State Board of Technical Education, Mumbai

TEACHING PLAN (TP)

Academic Year: **2025-26 (EVEN)**

Institute Code and Name: 0078- K. K. Wagh Polytechnic, Nashik
Semester: Fourth
Programme and Code: Chemical Engineering (CH)
Course Index: 403
Course and Code: Chemical Reaction Kinetics (CRK) - 314309
Name of Faculty: Mr. M. N. Shete
CLASS: SYCH

INDUSTRY EXPECTED OUTCOME

Operate various chemical reactors to produce products of desired quality with minimum cost.

COURSE LEVEL LEARNING OUTCOMES (COS)

- CO403-1 - Perform kinetics of different chemical reactions.
- CO403-2 - Use appropriate catalyst for enhancing rate of reaction.
- CO403-3 - Identify the order of reactions based on interpretation of batch reactor data.
- CO403-4 - Calculate the size of reactor by using the knowledge of design reactor equations.
- CO403-5 - Identify suitable reactor for best conversion of reactants.

TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category	Learning Scheme					Credits	Paper Duration	Assessment Scheme										
				Actual Contact Hrs/Week			SLH	NLH			Theory				Based on LL & TSL Practical				Based on SL		Total Marks
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
				CL	TL	LL					Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314309	Chemical Reaction Kinetics	CRK	DSC	4	-	4	-	8	4	03	30	70	100	40	25	10	25@	10	-	-	150

Total IKS Hrs for Sem.: 2 Hrs

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

THEORY LEARNING OUTCOME (TLO)

TLO No.	Title of TLO
TLO 1.1	State the parameters affecting the rate of reaction
TLO 1.2	Classify different types of reactions with examples.
TLO 1.3	Define reaction rate and rate constant with units.
TLO 1.4	Describe Kinetics of non-elementary reaction.
TLO 1.5	Calculate the frequency factor and activation energy for the given using given data analytically and graphically.

TLO 1.6	Compare the temperature dependency of rate constant in terms of Arrhenius law, transition state theory and collision theory.
TLO 2.1	State the characteristics of catalytic reaction.
TLO 2.2	Define homogeneous and heterogeneous with example.
TLO 2.3	Describe the specified properties of catalyst.
TLO 2.4	Describe various methods of catalyst preparation.
TLO 2.5	Explain the mechanism of solid gas phase catalytic reactions.
TLO 2.6	Describe catalyst poisoning.
TLO 2.7	Explain catalyst regeneration.
TLO 3.1	Define constant and variable volume batch reactor
TLO 3.2	Compare concentration and conversion term for constant volume system.
TLO 3.3	State the different methods to analyse the rate data for various order of reactions by integral method at constant volume batch reactor.
TLO 3.4	Derive the integrated rate equations for different order of reactions by integral method at constant volume reactor system.
TLO 3.5	Derive the integrated rate equation for first order, second order and zero order reaction in variable volume system by integral method.
TLO 4.1	Classify the different reactors with their applications.
TLO 4.2	Derive design equation for ideal batch reactor for constant and variable volume system.
TLO 4.3	State space time, space velocity and holding time.
TLO 4.4	Derive design equation for continuous stirrer tank reactor for constant and variable volume system.
TLO 4.5	Derive design equation for tabular flow reactor for constant and variable volume system.
TLO 5.1	Compare CSTR and PFR according to the given parameters.
TLO 5.2	Determine the optimized arrangement for CSTR and PFR in terms of conversion.

SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO-1 Basic and Discipline Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO-1**	**PSO-2**	**PSO-3**
CO1	3	2	2	2	1	1	3			
CO2	3	3	3	2	2	2	2			
CO3	3	2	2	1	1	1	1			
CO4	3	3	3	3	3	3	3			
CO5	2	3	3	2	2	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

Maharashtra State Board of Technical Education
Teaching Plan (TP)

K-1

Academic Year: 2025-26
Program: Chemical Engineering
Course: Chemical Reaction Kinetics (CRK)
Name of faculty: Mr. M. N. Shete

Institute Code: 0078
Course Code: 314309
Semester: Fourth (CH-4K)

Chap No. (Allotted Hrs.)	CO Mention only Number	TLO Mention only Number	Unit Name and Learning Content Title/ Details	No. of Lecture	Plan (From-To)	Actual Execution (From-To)	Teaching method/ Media	Remark
Unit - I Kinetics of Homogeneous Reactions								
1 (10)	**CO-1**	**TLO 1.1**	1.1 Concept of chemical kinetics, parameters affecting the rate of reaction.	1	18/12/2025		Blackboard, Books, media, PPT	
		TLO 1.2	1.2 Types of Reaction (Definition and examples): a. Homogenous and Heterogeneous b. Catalytic non-catalytic c. Molecularity of reaction d. Exothermic and endothermic e. Order of reaction f. Reversible and irreversible g. Elementary and non-elementary. h. Chain and non-chain reaction.	1	18/12/2025			
		TLO 1.3	1.3 Reaction rate, rate equation, rate constant, units of rate constant, concentration dependent term of rate equation.	2	19/12/2025 To 20/12/2025			
		TLO 1.4	1.4 Kinetics of non-elementary reactions (homogeneous reaction)	1	20/12/2025			
		TLO 1.5	1.5 Activation energy and its significance and numerical. **MKCL Quiz 1**	2	26/12/2025 To 27/12/2025			
		TLO 1.6	1.6 Derive temperature dependency of rate constant from: a. Arrhenius law b. Transition state theory c. Collision Theory d. Compare Arrhenius, Transition state theory and Collision Theory (Numerical). **Practice test 1**	3	27/12/2025 To 01/01/2026			

Chap No. (Allotted Hrs.)	CO Mention only Number	TLO Mention only Number	Unit Name and Learning Content Title/ Details	No. of Lecture	Plan (From-To)	Actual Execution (From-To)	Teaching method/ Media	Remark
Unit - II Catalysis								
2 (06)	**CO-2**	**TLO 2.1** **TLO 2.2**	2.1 Definition of catalysis, characteristics of catalytic reaction 2.2 Classification of catalytic reaction: homogeneous and heterogeneous	1	02/01/2026		Blackboard, Books, media, PPT	
		TLO 2.3	2.3 Properties of catalyst: Activity, specificity, porous and crystalline structure, kindling point	1	03/01/2026			
		TLO 2.4	2.4 Methods of catalyst preparation: Precipitation, Gel formation, Simple mixing of components, Impregnation.	1	03/01/2026			
		TLO 2.5	2.5 Mechanism of solid gas phase catalytic reactions	1	08/01/2026			
		TLO 2.6	2.6 Concept of catalyst deactivation, Concept of Promoters, Inhibitors and Accelerators, Catalyst Poisoning: Deposited poison, chemisorbed poison, selectivity poison, diffusion poison, stability poison.	1	08/01/2026			
		TLO 2.7	2.7 Catalyst regeneration **Practice test 2 and MKCL Quiz 2**	1	09/01/2026			
Unit - III Interpretation of Batch Reactor Data								
3 (18)	**CO-3**	**TLO 3.1**	3.1 Concept of constant volume batch reactor and variable volume batch reactor. **MKCL Test 1**	1	10/01/2026		Blackboard, Books, media, PPT	
		TLO 3.2	3.2 Constant Volume Batch Reactor: Relation between concentration and conversion for constant volume system	2	10/01/2026 To 15/01/2026			
		TLO 3.3	3.3 Methods of analysis of kinetic data/rate data: Integral method, differential method, half-life method, Ostwald isolation method and initial rate method **MKCL Quiz 3**	3	15/01/2026 To 17/01/2026			

Chap No. (Allotted Hrs.)	CO Mention only Number	TLO Mention only Number	Unit Name and Learning Content Title/ Details	No. of Lecture	Plan (From-To)	Actual Execution (From-To)	Teaching method/ Media	Remark
		TLO 3.4	3.4 General procedure for integral method for analysis of kinetic data for constant volume reactor a. Integrated rate expression for Irreversible unimolecular type first order reactions and its characteristics b. Integrated rate expression for irreversible bimolecular type second order reactions (2A → Product and A+B→ Product) and its characteristics c. Integrated rate expression for zero order reaction and its characteristics d. Integrated rate expression for nth order reaction (Numerical) **MKCL Quiz 4, MKCL Test 2**	6	17/01/2026 To 24/01/2026			
		TLO 3.5	3.5 Variable Volume Batch Reactor to Analyse the Kinetic Data/Rate Data: a. Concept of εA b. Integrated rate expression for irreversible unimolecular type first order reaction c. Integrated rate expression for irreversible bimolecular type second order reactions (2A → Product) d. Integrated rate expression for zero order reaction (Numerical) **Practice test 3, MKCL Quiz 5 and MKCL Test 2**	6	05/02/2026 To 12/02/2026			
Unit - IV Reactor Design								
4 (16)	**CO-4**	**TLO 4.1**	4.1 Classification of Reactors (diagram, brief description and applications): Batch, semi-batch, continuous stirred tank reactor, tubular/plug flow, fixed bed and fluidised bed reactor	2	12/02/2026 To 13/02/2026		Blackboard, Books, media, PPT	
		TLO 4.2	4.2 Performance/design equation for ideal batch reactor for constant and variable volume system with their graphical representation. (Numerical) **MKCL Quiz 6**	3	14/02/2026 To 20/02/2026			
		TLO 4.3	4.3 Concept of space time, space velocity, holding time for flow reactors. (Numerical)	2	21/02/2026 To 21/02/2026			
		TLO 4.4	4.4 Performance/design equation for steady state continuous stirrer tank reactor (CSTR) for constant and variable volume system with their graphical representation. (Numerical) **MKCL Quiz 7 and MKCL Test 3**	5	26/02/2026 To 28/02/2026			

Chap No. (Allotted Hrs.)	CO Mention only Number	TLO Mention only Number	Unit Name and Learning Content Title/ Details	No. of Lecture	Plan (From-To)	Actual Execution (From-To)	Teaching method/ Media	Remark
		TLO 4.5	4.5 Performance/design equation for steady state Plug flow reactor (PFR) for Constant and variable volume system with their graphical representation. (numerical) **Practice test 4**	4	05/03/2026 To 07/03/2026			
Unit - V Size Comparison of Plug Flow Reactor (PFR) and Continuous stirrer tank reactor (CSTR)								
5 (10)	**CO-5**	**TLO5.1**	5.1 Size comparison of single reactor: CSTR and PFR **MKCL Quiz 8**	2	07/03/2026 To 12/03/2026		Blackboard, Books, media, PPT	
		TLO 5.2	5.2 Multiple Reactor System: a. CSTR in series (equal size) b. Judgement of the best system for given conversion in PFR and CSTR connected in series c. CSTR connected in parallel d. PFR connected in series or in parallel e. PFR connected in series parallel combination. (Numericals) **Practice test 5 and MKCL Test 4**	8	13/03/2026 To 28/03/2026			

ASSESSMENT METHODOLOGIES/TOOLS

A. Formative assessment (Assessment for Learning) (FA-TH)

- Two Class Test of 30 Marks Each, Term Work Assessment of 25 Marks

B. Summative Assessment (Assessment of Learning) (SA-TH)

- End Term Theory Examination - 70 Marks

SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No.	Author	Title of Book	Publication
1	Octave Levenspiel	Chemical Reaction Engineering	Wiley India, New Delhi, 2015 ISBN-978-81-265-1000-9
2	J. M. Smith	Chemical Engineering Kinetics	Mc-Graw Hill New Delhi, 2015 ISBN 007*066574-5
3	H. Scott Fogler	Elements of Chemical Reaction Engineering	Pearson New Delhi, 2015 ISBN 978-81-317-1430-0
4	Srivastav R. P. S.	Elements of Chemical Reaction Engineering	Khanna Publishers, New Delhi, 2015 ISBN 81-7409-083-5

LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	https://onlinecourses.nptel.ac.in/noc19_ch20/preview	Chemical Reaction Engineering
2	https://nptel.ac.in/courses/103/103/103103153/	Chemical Reaction Engineering
3	https://nptel.ac.in/courses/103/101/103101141/#	Chemical Reaction Engineering
4	https://onlinecourses.nptel.ac.in/noc19_ch20/preview	Chemical Reaction Engineering

Note : Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Mr. M. N. Shete
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Dr. P. S. Bhandari
(Name & Signature of HOD)