Maharashtra State Board of Technical Education, Mumbai

K-2

LABORATORY PLAN (LP)

Academic Year: 2025-26

Date: 09/12/2025

Institute Name & Code: K. K. Wagh Polytechnic, Nashik-3 (0078) Class: SYCH

Program and Code: Chemical Engineering (CH) Course Index: CO403

Course Name: Chemical Reaction Kinetics Course Code &. Abbr.: 314309 (CRK)

Total Hrs: 60 Semester: 4th Scheme: K Name of Faculty: Mr. M.N.Shete

- **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 and Examination Scheme:**

Course Code	Course Title	Abbr	Course Categories	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

Abbreviations: CL- Class Room 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

- **Laboratory Learning Outcome (LLO)**

LLO No.	Title of LLO
LLO 1.1	Prepare 0.1 N solution of NaOH and ethyl acetate
LLO 1.2	Determine the effect of temperature on the activation energy
LLO 1.3	Plot of ln k vs 1/T give a straight line with slope equal to E/R
LLO 2.1	Prepare 0.1 N solution of NaOH and methyl acetate
LLO 2.2	Determine the effect of temperature on the activation energy
LLO 2.3	Plot of ln k vs 1/T give a straight line with slope equal to E/R
LLO 3.1	Titrate against 0.1 N NaOH solution using phenolphthalein indicator
LLO 3.2	Calculate conversion of methyl acetate at any time
LLO 3.3	Determine the concentration of methyl acetate at any time
LLO 4.1	Titrate against 0.1 N NaOH solution using phenolphthalein
LLO 4.2	Calculate conversion of ethyl acetate at any time
LLO 4.3	Determine the concentration of ethyl acetate at any time
LLO 5.1	Standardised NaOH and HCl solution with oxalic acid solution
LLO 5.2	Titrate against HCl solution using phenolphthalein indicator LLO
LLO 5.3	Calculate concentration of ethyl acetate
LLO 7.1	Measure the weight of the catalyst using weighing balance.
LLO 7.2	Measure the change in volume of water after putting catalyst in water.

LLO No.	Title of LLO
LLO 7.3	Measure the density of water LLO 7.4 Filter the catalyst using filter paper.
LLO 9.1	Prepare 0.1 N sodium hydroxide and ethyl acetate solution
LLO 9.2	Titrate against HCl solution using phenolphthalein indicator
LLO 9.3	Calculate normality of sodium hydroxide and hydrochloric acid
LLO 9.4	Determine concentration of ethyl acetate
LLO 11.1	Prepare 0.1 N sodium hydroxide, hydrochloric acid and ethyl acetate solution
LLO 11.2	Titrate against 0.1 N NaOH using phenolphthalein indicator
LLO 11.3	Calculate the concentration of ethyl acetate
LLO 15.1	Prepare 1N potassium Hydroxide solution
LLO 15.2	Two layers are separated by decantation method.
LLO 16.1	Prepare 0.02 N sodium hydroxide, 0.05 N hydrochloric acid and ethyl acetate solution
LLO 16.2	Calculate the concentration of ethyl acetate and sodium hydroxide
LLO 13.1	Prepare 0.1 N sodium hydroxide, hydrochloric acid and ethyl acetate solution
LLO 13.2	Titrate against 0.1 N NaOH using phenolphthalein indicator
LLO 13.3	Calculate the concentration of ethyl acetate
LLO 14.1	Prepare 0.1 N sodium hydroxide, hydrochloric acid and ethyl acetate solution
LLO 14.2	Determine rate constant by plotting the graph between time and concentration.

- **COs, Practical Laboratory Learning Outcome (LLOs) and Mapping:**

PR. No	Relevant COs	Practical - Laboratory Learning Outcome (LLO)	Name of Experiments/Assignment/ Sheet/ Job/ Project Activity	Planned Dates		Actual Date of conduction	Remark/ Assess-ment Date with Staff sign
				From	To		
1	CO 403. 1	LLO 1.1 LLO 1.2 LLO 1.3	Determination of activation energy of saponification of ethyl acetate and sodium hydroxide at various temperatures.	B-15/12/25	B-22/12/25		
				C-16/12/25	C-23/12/25		
				A-17/12/25	A-24/12/25		
2	CO 403. 1	LLO 2.1 LLO 2.2 LLO 2.3	Determination of the activation energy of the reaction by hydrolysis of methyl acetate at various temperatures.	B-22/12/25	B-29/12/25		
				C-23/12/25	C-30/12/25		
				A-24/12/25	A-31/12/25		
3	CO 403. 1	LLO 3.1 LLO 3.2 LLO 3.3	Determination of Arrhenius rate constants for acidic hydrolysis of methyl acetate at various temperatures.	B-29/12/25	B-05/01/26		
				C-30/12/25	C-06/01/26		
				A-31/12/25	A-07/01/26		
4	CO 403. 1	LLO 4.1 LLO 4.2 LLO 4.3	Determination of Arrhenius rate constant for acidic hydrolysis of ethyl acetate at various temperatures.	B-05/01/26	B-12/01/26		
				C-06/01/26	C-13/01/26		
				A-07/01/26	A-14/01/26		
5	CO 403. 1	LLO 5.1 LLO 5.2 LLO 5.3	Determination of the rate constant for the saponification reaction of ethyl acetate and sodium hydroxide.	B-12/01/26	B-19/01/26		
				C-13/01/26	C-20/01/26		
				A-14/01/26	A-21/01/26		

PR. No	Relevant COs	Practical - Laboratory Learning Outcome (LLO)	Name of Experiments/Assignment/ Sheet/ Job/ Project Activity	Planned Dates		Actual Date of conduction	Remark/ Assess-ment Date with Staff sign
				From	To		
6	CO 403. 2	LLO 7.1 LLO 7.2 LLO 7.3	Determination of the solid density of a catalyst particle.	B-19/01/26	B-02/02/26		
				C-20/01/26	C-27/01/26		
				A-21/01/26	A-28/01/26		
7	CO 403. 3	LLO 9.1 LLO 9.2 LLO 9.3 LLO 9.4	*Determination of order of reaction for saponification of ethyl-acetate with sodium hydroxide.	B-02/02/26	B-09/02/26		
				C-27/01/26	C-03/02/26		
				A-28/01/26	A-04/02/26		
8	CO 403. 4	LLO 11.1 LLO 11.2 LLO 11.3	Determination of the kinetics of the reaction between ethyl acetate and sodium hydroxide in an isothermal batch reactor.	B-09/02/26	B-16/02/26		
				C-03/02/26	C-10/02/26		
				A-04/02/26	A-11/02/26		
9	CO 403. 4	LLO 15.1 LLO 15.2	Determination of kinetics of Bio-diesel synthesis from vegetable oils by Transesterification	B-16/02/26	B-23/02/26		
				C-10/02/26	C-17/02/26		
				A-11/02/26	A-18/02/26		
10	CO 403. 5	LLO 16.1 LLO 16.2	The performance of three equal volumes of CSTR's in series for the saponification of ethyl acetate and sodium hydroxide reactions	B-23/02/26	B-02/03/26		
				C-17/02/26	C-24/02/26		
				A-18/02/26	A-25/02/26		
11	CO 403. 4	LLO 13.1 LLO 13.2 LLO 13.3	Determination of rate constant by the half-life period of the saponification reaction between ethyl acetate and sodium hydroxide in an isothermal batch reactor	B-02/03/26	B-09/03/26		
				C-24/02/26	C-03/03/26		
				A-25/02/26	A-04/03/26		
12	CO 403. 4	LLO 14.1 LLO 14.2	Determination of the kinetics of saponification of ethyl acetate and sodium hydroxide in a continuous stirrer tank reactor.	B-09/03/26	B-16/03/26		
				C-03/03/26	C-10/03/26		
				A-04/03/26	A-11/03/26		
13	**CO 403-1:5**	**NA**	**Beyond Syllabus Practical**	**B-16/03/26**	**B-23/03/26**		
				C-10/03/26	**C-17/03/26**		
				A-11/03/26	**A-18/03/26**		

- **ASSESSMENT METHODOLOGIES/TOOLS**

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

- Term Work Assessment 25 Marks.

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

- End Term Practical Examination 25 Marks.

- **Laboratory Equipment / Instruments / Tools / Software required**

Sr. No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	ISOTHERMAL BATCH REACTOR To determine the kinetic parameters affecting progress of a Chemicals reaction. Power 500 Watt (w), Voltage 240 Volt (v), Materials S S Metal Reactor of Capacity Min. 2 Ltrs fitted with Stirrer having Impeller and shaft coupled with DC Motor. Double walled Water Bath, insulated and fitted with agitator having Impeller and shaft coupled with DC Motor with the help of bearings. Heater whose temperature controlled by PID Controller, 0-199.9° C. Reactor, water bath, Impeller and shaft should be made of stainless steel. RPM of the stirrer should be displayed with the help of RPM sensor. Operating/instruction manual and sample calculations with Photographs, line diagram, detailed design and drawing of the impeller, must be provided with equipment. Equipments has to be demonstrated at college site, results should be repeatable within ±5 to 10 % of the sample calculations provided.	1,2,3,4,5 9,10,11, 14,15
2	ISOTHERMA PLUG FLOW REACTOR (PFR) To determine the Reaction Rate Constant and effect of temperature on saponification reaction in Isothermal Plug Flow Reactor. Helical Coiled Tube Type Reactor of min Volume 0.5Ltrs. Double walled Water Bath, insulated with Ceramic Wool and reactor fitted with stirrer having Impeller and shaft coupled with motor and Heater whose temperature controlled by PID Controller, 0-199.9° C. Feed Circulation by pump and flow measurement device. Reactor, water bath, Impeller, shaft and feed tanks should be made of stainless steel Temperature measurement done by Temperature Sensors of RTD PT-100 type with Digital Temperature Indicator (0-199.9 °C). Operating/instruction manual consisting of experimental procedure, block diagram etc. and sample calculations should to be provided along with equipment. Equipments has to be demonstrated at college site, results should be repeatable within ±5 to 10% of the sample calculations provided.	12
3	ISOTHERMAL CONTINUOS STIRRED TANK REACTOR To determine the Reaction Rate Constant and effect of temperature on Saponification Reaction in Isothermal CSTR. Reactor of min capacity 2 Ltrs fitted with agitation system and shaft coupled with Motor and min. four Baffles. Double walled Water Bath, insulated with Ceramic Wool should be fitted with Agitator having min 4 square bladed Impeller and shaft coupled with motor and Heater whose temperature controlled by PID Controller, 0-199.9° C. Feed Circulation done by compressed air from Feed Tanks, 1.2 mm thick, capacity 20 liters each, made of stainless steel and Flow Measurement by Rotameter. Reactor, water bath, baffles, Impeller, shaft and feed tanks should be made of stainless steel and Piping of Stainless Steel and PU pipe. Bourdon type pressure gauge of 0-2 Kg/cm 2 and Pressure Regulator of 0-2 Kg/cm 2 should be provided. Temperature measurement done by Temperature Sensors of RTD PT-100 type with Digital Temperature Indicator (0-199.9 °C). Electricity Supply: Single Phase, 220 V AC, 50 Hz, 5-15Amp combined socket with earth connection. Floor Drain. Laboratory Glassware and Chemicals required for analysis as per the system adopted.	13, 16

- **References:**

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 Reaction Engineering	Mc-Graw Hill New Delhi, 2015 ISBN 007*066574-5
3	H. Scott Fogler	Chemical Reaction Engineering	Pearson New Delhi, 2015 ISBN 978-81-317-1430-0
4	Srivastav R. P. S.	Chemical Reaction Engineering	Khanna Publishers, New Delhi, 2015 ISBN 81-7409-083-5

Learning Websites & Portal

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

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