Format K1

Maharashtra State Board of Technical Education, Mumbai

TEACHING PLAN (TP) Academic Year: **2026-27 (ODD)**

Institute Code and Name: 0078- K. K. Wagh Polytechnic, Nashik **Semester:** Third
Programme and Code: Chemical Engineering (CH) **Course Index:** 306
Course and Code: Introduction to Analytical Instruments for Chemical Analysis (IAIC)
Name of Faculty: Dr. P. S. Bhandari **Class: SYCH**

INDUSTRY EXPECTED OUTCOME

The course should be taught and implemented with the aim to develop required skills in students so that they are able to acquire the following industry outcome: The course is expected to develop an ability to select suitable analytical instruments, interpret the results obtained by using the analytical instruments thereby monitor and control the progress of process/operation.

COURSE LEVEL LEARNING OUTCOMES (COS)

CO306.1: Differentiate between different instrumental methods of chemical analysis as per requirement.
CO306.2: Select relevant Spectroscopy based method of analysis based on nature of sample.
CO306.3: Select appropriate chromatography based analytical instruments for the given analyte.
CO306.4: Interpret the results of thermoanalytical method to decide the thermal stability of a material
CO306.5: Identify analytical instruments for composition and crystallographic study of a relevant sample.

TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbreviation	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
				CL	TL	LL			-	-	FA - TH	SA - TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313017	Introduction to Analytical Instruments for Chemical Analysis	IAIC	SEC	02	02	-	-	04	03	-	-	-	-	-	50	20	-	-	-	-	50

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	Explain methods of chemical analysis.
TLO 1.2	Differentiate between physical method and instrument-based method of analysis.
TLO 1.3	State the advantages and limitations of Chemical and Instrumental methods.
TLO 1.4	Classify Instrumental methods of chemical analysis.
TLO 2.1	Explain electromagnetic spectrum and Parameters of electromagnetic radiations.
TLO 2.2	Explain Principle and applications of Spectroscopy.
TLO 2.3	Describe spectroscopy based analytical instruments.
TLO 3.1	Explain chromatographic method of analysis.
TLO 3.2	Distinguish between chromatography and spectroscopy.
TLO 3.3	State different types of chromatographic methods.
TLO3.4	Explain typical features of commonly used chromatography based analytical instruments.
TLO 4.1	Select the analytical instrument for determining thermal stability of given material.
TLO 4.2	Identify thermal characteristics of material.
TLO 5.1	State the applications of analytical instruments based on refraction and diffraction of light.
TLO 5.2	Select the analytical instrument for determining composition of mixture and determine water content in given sample.

SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)	
	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	1	1	3	1
CO2	3	2	1	1	-	1	1	3	1
CO3	3	2	1	1	1	1	1	3	1
CO4	3	2	1	1	1	1	1	3	1
CO5	3	2	1	1	-	1	1	3	1
Legends :- High:03, Medium:02, Low:01, No Mapping: - *PSOs are to be formulated at institute level									

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 Introduction to Instrumental Methods of analysis								
1 (04)	**CO-1**	**TLO 1.1**	1.1 Purpose/ Necessity of Chemical analysis and methods of analysis a. Quantitative Analysis b. Qualitative Analysis c. Chemical Methods d. Physical methods	01	01.07.2026		Chalk & Board/Books/ media/PPT/ Simulation/ Instruments or Model	
		TLO 1.2	1.2 Differentiate between physical properties and analytical methods of measurement.	01	02.07.2026			
		TLO 1.3	1.3 Advantages and limitations of Chemical and Instrumental methods.	01	08.07.2026			
		TLO 1.4	1.4 Classification of basic Instrumental method of chemical analysis: a. Electrochemical method b. Optical methods c. Radiometric method d. Mass Spectrometry e. Nuclear Magnetic Resonance	01	09.07.2026			
Unit - II Spectroscopy								
2(08)	**CO-2**	**TLO 2.1**	Electromagnetic Spectrum depicting wavelength, frequencies of electromagnetic radiations. Properties or parameters of electromagnetic radiations such as: a. Wavelength b. Frequency c. Velocity d. Wave number. e. Definition of spectroscopy	02	15.07.2026		Chalk & Board/Books/ media/PPT/ Simulation	1 Extra

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 2.2	2.2 UV-Visible spectrophotometer: Introduction, Principle, Construction, Working and Application.	02	16.07.2026 to 22.07.2026		Chalk & Board/Books/ media/PPT/ Simulation/ Instruments or Model	
		TLO 2.3	2.3 Atomic Absorption Spectroscopy: Introduction, Principle, Construction, Working and Application.	02	23.07.2026 to 29.07.2026			
		TLO 2.4	2.4 Principle and Application of Mass Spectroscopy.	02	30.07.2026 to 05.08.2026			1 Extra
Unit - III Chromatography								
3(10)	**CO-3**	**TLO 3.1**	3.1 Introduction of chromatography: Purpose and Principle.	01	06.08.2026		Chalk & Board/Books/ media/PPT/ Simulation/ Instruments or Model	
		TLO 3.2	3.2 Difference between spectroscopy and Chromatographic based methods.	01	13.08.2026			
		TLO 3.3	3.3 Introduction, Principle and Applications of following type of chromatography: a. Adsorption Chromatography b. Partition Chromatography c. Liquid - Liquid Chromatography d. Gas Chromatography(GC) e. Paper Chromatography f. Thin Layer Chromatography (TLC) g. High Performance Liquid chromatography (HPLC)	04	19.08.2026 to 02.09.2026			
		TLO 3.4	3.4 Introduction of Gas chromatography: Purpose and Principle.	02	03.09.2026 to 09.09.2026			
		TLO 3.5	3.5 Introduction and Application of Gas Chromatography - Mass Spectrometry (GCMS) and Liquid Chromatography - Mass Spectrometry (LC-MS)	02	10.09.2026 to 16.09.2026			

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 - IV Thermoanalytical Methods								
4(04)	**CO-4**	**TLO 4.1**	4.1 Introduction, Principle and Applications of Thermogravimetric method of analysis (TGA).	01	17.09.2026		Chalk & Board/Books/ media/PPT/ Simulation/ Instruments or Model	
		TLO 4.2	4.2 Thermoanalytical methods based on thermal characteristics of material: a. Differential Scanning Calorimetry (DSC) b. Differential Thermal analysis (DTA)	03	23.09.2026 to 24.09.2026			1 Extra
Unit - V Miscellaneous Methods of Analysis								
5(04)	**CO-5**	**TLO 5.1**	5.1Introduction, Principle, Construction, working and Applications of Abbe's Refractometer.	01	30.09.2026		Chalk & Board/Books/ media/PPT/ Simulation/ Instruments or Model	
		TLO 5.1	5.2 Introduction, Principle and Applications of X ray diffractometer (XRD).	01	01.10.2026			
		TLO 5.2	5.3 Introduction, Principle and Applications of Elemental analyser (CHN analyser).	01	07.10.2026			
		TLO 5.2	5.4 Introduction, Principle and Applications of Karl Fischer Titrator.	01	08.10.2026			

ASSESSMENT METHODOLOGIES/TOOLS

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

Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering:

- 60% weightage is to process
- 40% weightage to product

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

Continuous Assessment based on Process and Product related performance indicators. Each practical will be assessed considering:

- 60% weightage to Process
- 40% weightage to Product

SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No.	Author	Title of Book	Publication
1	B. K. Sharma	Instrumental Method of Chemical Analysis	GOEL Publishing House, Meerut (India) ISBN -81-87224-98-3
2	Douglas A. Skoog F. James Holler Stanley R. Crouch	Principle of Instrumental Analysis	Cengage ISBN 9789353506193
3	P. C. Jain, Monika Jain	Engineering Chemistry	Dhanpat Rai Publishing Company,17th Edition ISBN 978-9352160006
4	Gurdeep R. Chatwal and Sham K. Anand	Instrumental Methods of Chemical Analysis (5th Edition)	Himalaya Publishing House ISBN 978- 9351420880
5	R. Gopalan, K. Rangarajan P.S.Subramanian	Elements of Analytical Chemistry (3rd Edition)	S. Chand & Sons ISBN: 978-81-8054- 765-2

LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	https://nptel.ac.in/courses/103108100 https://www.youtube.com/watch?v=UHYfgwjE2i4	Introduction to the Modern Instrumental Methods of Analysis by Dr. J.R. Mudakavi
2	https://www.youtube.com/watch?v=R_tgHUUXiE4	Common Analytical Instruments
3	https://www.youtube.com/watch?v=O39avevqndU	Ultraviolet / Visible Spectroscopy (UV- Vis)
4	https://www.youtube.com/watch?v=P9iAV-x5y-w	The Science Behind UV Vis Spectroscopy: Everything You Need To Know
5	https://www.youtube.com/watch?v=uSG8ANB	Gas Chromatography- Explainer Video
6	https://www.youtube.com/watch?v=Wap9pQEN4gE	Atomic Absorption Spectroscopy (AAS) Explained
7	https://www.youtube.com/watch?v=UycPljfrnWo	Quickly Understand Gas Chromatography
8	https://www.petro-online.com/news/analytical-instrumentation/11/gr-scientific/water-content-determination-of-crude-oils- and-petroleum-products-by-coulometric-karl-fischer-titration/34652	Water Content Determination of Crude Oils and Petroleum Products by Coulometric Karl Fischer Titration
9	https://www.youtube.com/watch?v=QHMzFUo0NL8	What is X-ray Diffraction?
10	https://www.iitk.ac.in/che/PG_research_lab/pdf/resources/TGA-DSC-reading-material.pdf	Thermal Analysis Thermogravimetry (TG) & Differential Scanning Calorimetry (DSC)
11	https://webbook.nist.gov/chemistry	NIST chemistry workbook

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