

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF INDUSTRIAL CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction			
Program: Bachelor in Science (Honors/ Honors with Research)		Semester - VIII	Session: 2024-2025
1	Course Code	ICSE-11T	
2	Course Title	MODERN ANALYTICAL TECHNIQUES-II	
3	Course Type	DSE	
4	Pre-requisite(if,any)	As per program	
5	Course Learning Outcomes(CLO)	<ul style="list-style-type: none"> ➤ Demonstrate Proficiency in Operating UV-Visible Spectrophotometers ➤ Interpret Infrared Spectra to Identify Functional Groups ➤ Analyze NMR Spectra to Determine Molecular Structure ➤ Quantify Elemental Concentrations Using Atomic Absorption Spectroscopy (AAS) ➤ Apply Spectroscopic Techniques to Solve Analytical Problems 	
6	Credit Value	3 Credits	Credit = 15 Hours -learning & Observation
7	Total Marks	Max. Marks: 100	Min Passing Marks:40

PART -B: Content of the Course

Total No.of Teaching-learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No.of Period
I	UV Spectroscopy: Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, effect of solvents on electronic transitions, formation and designation of absorption bands conjugated systems and transition energies, unsaturated carbonyl compounds, dienes and conjugated polyenes, Woodward-Fieser rules.	12
II	IR Spectroscopy: Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, calculation of vibrational frequencies, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, fingerprint region, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, acids, anhydrides), applications of infrared spectroscopy.	11
III	NMR Spectroscopy: Introduction, theory of NMR spectroscopy, Instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling and stereostructure, proton exchange reactions, principle of C-13 NMR spectroscopy, Relaxation and dynamic processes - Spin lattice relaxation (T1) and Spin - spin relaxation (T2) measurements. Interpretation of NMR spectra of some representative compounds.	11
IV	Atomic Absorption Spectrophotometry: Introduction, Principle, Instrumentation, Interferences- Spectral, Ionization, Physical and Refractory compound formation, Sample preparation, Internal standard and standard addition calibration and applications of AAS.	11
Keywords	<i>Molecular Spectroscopy, Absorption, Instrumentation, Frequency, Nucleolus, NMR, AAS</i>	

Signature of Convener & Members (CBoS):

PART-C : Learning Resources		
Text Books, Reference Books and Others		
Text Books Recommended –		
<ol style="list-style-type: none"> 1. Kaur, H. (2018). <i>Spectroscopy</i>. Pragati Prakashan. 2. Sharma, B. K. (2010). <i>Spectroscopy comprehension</i>. Goel Publishing House. 		
Reference Books Recommended –		
<ol style="list-style-type: none"> 1. Pavia, D. L., Lampman, G. M., & Kriz, G. S. (2008). <i>Introduction to spectroscopy</i> (3rd ed.). Brooks/Cole. 2. Williams, H., & Fleming, I. (2007). <i>Spectroscopic methods in organic chemistry</i> (5th ed.). McGraw-Hill Education. 3. Kemp, W. (2011). <i>Organic spectroscopy</i> (3rd ed.). Palgrave Macmillan. 4. Skoog, D. A., West, D. M., & Holler, F. J. (1995). <i>Fundamentals of analytical chemistry</i> (7th ed.). Harcourt Brace College Publishers 		
Online Resources–		
<ul style="list-style-type: none"> ➤ https://www.spectroscopyonline.com/ ➤ https://webbook.nist.gov/chemistry/ ➤ https://www.rsc.org/spectra/ ➤ https://www.wiley.com/en-us/Spectra+Lab-p-9781119451987 ➤ https://axial.acs.org/spectroscopy-resource-center/ 		
Online Resources–		
➤ e-Resources / e-books and e-learning portals		
PART-D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks: 100 Marks		
Continuous Internal Assessment(CIA):30 Marks		
End Semester Exam(ESE):70 Marks		
Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 20 +20 Assignment/Seminar- 10 Total Marks -30	Better marks out of the two Test / Quiz+ obtained marks in Assignment shall be considered against 30 Marks
End Semester Exam (ESE):	Two section – A & B Section A: Q1. Objective – 10 x1= 10 Mark; Q2. Short answer type- 5x4 =20Marks Section B: Descriptive answer type qts., 1 out of 2 from each unit- 4x10=40Marks	

Name and Signature of Convener & Members of CBoS:

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COURSE CURRICULUM

PART-A: Introduction		
Program: Bachelor in Science (Honors/ Honors with Research)		Semester VIII
Session: 2024-2025		
1	CourseCode	ICSE-11P
2	CourseTitle	MODERN ANALYTICAL TECHNIQUES-II LAB. COURSE
3	CourseType	DSE
4	Pre-requisite(if,any)	As per program
5	Course Learning Outcomes(CLO)	<ul style="list-style-type: none"> ➤ To Learn the structure elucidation of compound by spectroscopic data. ➤ To learn Spectrophotometric estimation of data. ➤ To learn the pH Metry ➤ To learn the chromatographic separation.
6	CreditValue	1 Credits Credit =30 Hours Laboratory or Field learning/Training
7	TotalMarks	Max.Marks:50 Min Passing Marks:20

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	<ol style="list-style-type: none"> 1. Project on structure elucidation by spectroscopic data of ¹H-NMR, ¹³C-NMR, IR, UV spectroscopy and Mass spectrometry. (Experimental data sheet different simple compound can be provided to the student as a task eg. ethanol, propanol, ethyl acetate, nitrophenol, toluene, 1,2,2-tribromoethane etc.) 2. Determination of Fe (II) in a sample of well water with thiocyanate as complexation agent, spectrophotometrically 3. Determination of λ_{max} of Potassium permanganate (KMnO₄) solution. 4. Verification of the Lambert Beer's Law for KMnO₄ / K₂Cr₂O₇ and determination of concentration given unknown solution of the compound. 5. Determination of Aluminum in a given sample solution, spectrophotometrically. 6. Determination of concentration of sodium in an aqueous solution by using a flame photometer. 7. Determination of concentration of an acidic solution by pH metric titrations. 8. Determination of the isoelectric point of a protein. 9. The standardization of an Fe (II) solution with a standard dichromate solution over Pt and Calomel assembly. 10. Determination of concentration of Ce (IV) Sulfate solution with a standard Fe (II) Solution over Pt and calomel assembly. 11. Separation of permanganate and dichromate ions from a binary mixture on an alumina column 	30
Keywords	Structure elucidation, pH-Metry, Potentiometry, Chromatographic experiment paper and column, NMR, IR, UV-Visible, Mass.	

PART-C: Learning Resources	
Text Books, Reference Books and Others	
Text Books Recommended –	
<ol style="list-style-type: none"> 1. Chatwaal, R., & Anand, B. (2000). <i>Instrumental Methods of Chemical Analysis</i>. Himalaya Publishing House. 2. Janarthanam, P. B. (2000). <i>Physico Chemical Techniques of Analysis (Vol. I & II)</i>. Asian Publishing. 3. Sharma, B. K. (2008). <i>Instrumental Methods of Chemical Analysis</i>. Goel Publications. 	
Reference Books Recommended –	
<ol style="list-style-type: none"> 1. Skoog, D. A., & Saunders, Jr., J. B. (1985). <i>Principles of Instrumental Methods of Analysis (3rd ed.)</i>. College Publications. 2. Willard, H. H., Merritt, L. L., Dean, J. A., & Settle Jr., F. A. (1991). <i>Instrumental Methods of Analysis (7th ed.)</i>. Saunders College Publishing. 3. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). <i>Principles of Instrumental Analysis (6th ed.)</i>. Cengage Learning. ISBN 0-495-01201-7 4. Pavia, D. L., Lampman, G. M., Kriz, G. S., & Vyvyan, J. A. (2014). <i>Spectroscopy (5th ed.)</i>. Cengage Learning. 	
Online Resources:	
<ul style="list-style-type: none"> ➤ https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/spectro.htm ➤ https://webbook.nist.gov/chemistry/ ➤ https://edu.rsc.org/resources/spectroscopy/847.article ➤ https://pubs.acs.org/doi/abs/10.1021/es203272z ➤ https://www.eku.edu/phygeosast/directory/ 	

PART-D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods:		
Maximum Marks: 50 Marks		
Continuous Internal Assessment(CIA):15 Marks		
End Semester Exam(ESE):35Marks		
Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): 10 &10 Assignment/Seminar +Attendance- 05 Total Marks -15	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against 15 Marks
End Semester Exam (ESE):	Laboratory / Field Skill Performance: On spot Assessment EE. Performed the Task based on lab. work - 20 Marks FF. Spotting based on tools & technology (written) – 10 Marks GG. Viva-voce (based on principle/technology) - 05 Marks	Managed by Course teacher as per lab. status

Name and Signature of Convener & Members of CBoS: