## School of Chemistry Faculty of Sciences University of the Punjab, Lahore Course Outline Semester-VIII



Program	BS Chemistry	Course Code	Chem-453	Credit Hours	2
Course Tit	Electroanalytical Tec	chnique-II	<b>Course Type</b>	Major (Electiv	e)
		Course Introd	uction		
the details a voltammetr Voltammetr electrodes. Polarograph advantages potential; q Amperometr amperometr	is organized to understand about the theory and applie y, polarography, and amper- ry: Excitation signals in ver- ry, Cyclic Voltammetry, ny: Introduction and princ of DME (dropping merce ualitative and quantitative a try: Principle of Amperom- ric titrations with one odes, applications of amper-	cations of adva rometry. oltammetry, vo , Stripping n iple of polarog cury electrode) aspects of polar netry, types of micro-electro rometry.	nced electroana ltammetric Inst nethods, voltan raphy, basic in ; limiting and ographic analys amperometry a ode, amperom	alytical techniques in rumentation, Hydro mmetric with ultra strumentation, work residual current; ha sis. and amperometric ti	ncluding dynamic a-micro- king and alf-wave
	pletion of the course, the st	Learning Outo			
2. 1 3.	Deal with electroanalytical learn the details about th techniques including voltar Understand the mechanism Apply these techniques for	e theory and nmetry, polarog s involved in th	graphy, and amplese techniques.	perometry.	nalytical
	Course Co	ntent		Assignments/R	leadings
Week 1	Voltammetry, Excitation signals in volta Instrumentation	mmetry, Voltar	nmetric	Class based Learning/Test	
Week 2	Hydrodynamic Voltamme	try		Class based Learning/Test	
Week 3	Cyclic Voltammetry, Strip	pping methods		Class based Learning/Test	
Week 4	Voltammetric with ultra-n	nicro-electrode	S	Class based Learning/Test	
Week 5	<b>Polarography,</b> Introduction and principle	of polarograph	у	Class based Learning/Test	
Week 6	Basic instrumentation			Class based Learning/Test	
Week 7	Working and advantages of electrode)	of DME (dropp	ing mercury	Class based Learning/Test	

Week 8	Mid Term Assessment	
Week 9	Limiting and residual current, half-wave potential.	Class based Learning/Test
Week 10	Qualitative and quantitative aspects of polarographic analysis.	Class based Learning/Test
Week 11	Amperometry, Principle of Amperometry	Class based Learning/Test
Week 12	Types of amperometry and amperometric titrations	Class based Learning/Test
Week 13	Amperometric titrations with one micro electrode	Class based Learning/Test
Week 14	Amperometric titration with twin microelectrodes	Class based Learning/Test
Week 15	Applications of amperometry	Class based Learning/Test
Week 16	Submission of assignments. If required, then discuss the whole chapter for final term exams preparation	
Textbooks	and Reading Material	
<ol> <li>Ola Hea Hea Hea Hea Hea Hea Hea Hea Hea He</li></ol>	<ul> <li>nded Books:</li> <li>adiji, A. T., Oladele, J. O., &amp; Ajayi, E. I. (Eds.). (2024). Nut alth: Principles and Applications.</li> <li>nnert, K. (2024). Optical Fiber Current and Voltage Sensors nty, M. J. (2019). Image analysis, classification and change sing: with algorithms for Python.</li> <li>rd, A. J., Faulkner, L. R., &amp; White, H. S. (2022). Electroche damentals and applications. John Wiley &amp; Sons.</li> <li>Mendham, R.C. Denney, J.D. Barnes, &amp; M. Thomas. (2000) antitative chemical analysis. prentice hall.</li> <li>pog, D. A., West, D. M., Holler, F. J., &amp; Crouch, S. R. (1990) hybrid chemistry (Vol. 33, pp. 53-55). Fort Worth: Saunder</li> </ul>	detection in remote mical methods: . Vogel's textbook of 5). Fundamentals of
	Teaching Learning Strategies	
• • •	Lecturing using white/black board/Multimedia Written Assignments/presentations/ Task related to assign Class activities and Discussion Quiz about last lecture Class Presentations Audio/visual Aids/ Tutorials	ed topics
	Assignments: Types and Number with Calend	lar
	Assignments, quiz, Tasks, Presentation, etc.	

	Assessment			
Sr. No.	Elements	Weightage	Details	
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.	
2.	Formative Assessment	25%	Continuous assessment includes classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.	
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.	

		Semeste	r-VIII			
Program	m BS Chemistry	Course Code	Chem-454	Cre	dit Hours	1
Course T	itle Electroanalytical T	Cechniques-2 (l	Lab) Cours	se	Major (Electi	ive)
		Course Intro	oduction			
	e is organized to provide		electroanaly	ical tech	niques like vo	ltammetry
-	ative analysis of various a					
	of ferricyanide ion using		lastrada			
	of acetaminophen using gon of carbon paste electron		lectione			
	ation of electrode surface		clic voltamme	etry using	g potassium fe	rricvanide
solution				,	5 P • • • • • • • • • •	j
Effect of s	scan rate on the electrode	properties using	g potassium fo	erricyani	de solution	
	ation of half-wave potenti		•			
	ation of metal ions using a	11 0	•	•	on paste electro	ode
Determina	ation of various organic m			studies		
		Learning O				
	mpletion of the course, th					
1.	Learn the in-hand use o	•	-	s like vol	tammetry in	
2	quantitative analysis of					
2. 3.	Obtain relevant informa Interpret the results of a		mmetric analy	/ses.		
5.		Content			Assignments/	Poodings
Week 1	Reduction of ferricyanic		alactroda		Lab based	Keaunigs
WEEK I	Reduction of ferric yains	te fon using i t	electiode		Performance/	Lah
					reports	Luo
Week 2	Oxidation of acetamino	phen using glas	sy carbon ele	ctrode	Lab based	
			2		Performance/I	Lab
					reports	
Week 3	Oxidation of acetamino	phen using glas	sy carbon ele	ctrode	Lab based	
					Performance/I	Lab
Wash 4	Droporation of carbon	acto ala atra da			reports	
Week 4	Preparation of carbon pa	aste electrode			Lab based Performance/I	ah
					reports	Lau
	1				10p010	
Week 5	Preparation of carbon pa	aste electrode				
Week 5	Preparation of carbon pa	aste electrode			Lab based Performance/I	Lab
Week 5	Preparation of carbon pa	aste electrode			Lab based	Lab
Week 5 Week 6	Determination of Electr	ode surface are	•••	2	Lab based Performance/I reports Lab based	
		ode surface are	•••	2	Lab based Performance/I reports Lab based Performance/I	
Week 6	Determination of Electr voltammetry using pota	ode surface are ssium ferricyan	ide solution		Lab based Performance/I reports Lab based Performance/I reports	
	Determination of Electr voltammetry using pota Determination of Electr	ode surface are ssium ferricyan ode surface area	ide solution		Lab based Performance/I reports Lab based Performance/I reports Lab based	Lab
Week 6	Determination of Electr voltammetry using pota	ode surface are ssium ferricyan ode surface area	ide solution		Lab based Performance/I reports Lab based Performance/I reports Lab based Performance/I	Lab
Week 6	Determination of Electr voltammetry using pota Determination of Electr	ode surface are ssium ferricyan ode surface area	ide solution		Lab based Performance/I reports Lab based Performance/I reports Lab based	Lab

Week 9	Effect of scan rate on the electrode properties using	Lab based
WEEK 9	potassium ferricyanide solution	Performance/Lab
	potassiam terrieyande solation	reports
Week 10	Effect of scan rate on the electrode properties using	Lab based
WCCK IU	potassium ferricyanide solution	Performance/Lab
	potassiam terrieyande solation	reports
Week 11	Determination of half-wave potential for various analytes	Lab based
	1	Performance/Lab
		reports
Week 12	Determination of half-wave potential for various analytes	Lab based
		Performance/Lab
		reports
Week 13	Determination of metal ions using anodic stripping	Lab based
	voltammetry by carbon paste electrode	Performance/Lab
		reports
Week 14	Determination of metal ions using anodic stripping	Lab based
	voltammetry by carbon paste electrode	Performance/Lab
		reports
Week 15	Determination of various organic molecules using	Lab based
	voltammetric studies	Performance/Lab
		reports
Week 16	FINAL TERM EXAMS	
	<b>Textbooks and Reading Material</b>	
Recomme	nded Books:	
	ndiji, A. T., Oladele, J. O., & Ajayi, E. I. (Eds.). (2024). Nu	trition and Diet in Health:
	nciples and Applications.	
	hnert, K. (2024). Optical Fiber Current and Voltage Sensors.	
	nty, M. J. (2019). Image analysis, classification and cha	ange detection in remote
	sing: with algorithms for Python. rd, A. J., Faulkner, L. R., & White, H. S. (2022). H	Electrophomical matheds:
	damentals and applications. John Wiley & Sons.	Siechoenennear methous.
	Mendham, R.C. Denney, J.D. Barnes, & M. Thomas. (20	)00). Vogel's textbook of
	initiative chemical analysis. prentice hall.	(00). Vogers textbook of
q	Teaching Learning Strategies	
•	Lecturing using white/black board/Multimedia	
	Written Assignments/presentations/ Task related to assigne	d topics
•	- WILLEH ASSIZITTETILS/DIESCHLAUUUS/ TASK TETATETI TO ASSIZITE	
•		a topics
•	Class activities and Discussion	
•	Class activities and Discussion Quiz about last lecture	u topics
•	Class activities and Discussion Quiz about last lecture Class Presentations Audio/visual Aids/ Tutorials	u topics
• • •	Class activities and Discussion Quiz about last lecture	-

	Assessment				
Sr. No.	Elements	Weightage	Details		
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.		
2.	Formative Assessment	25%	Continuous assessment includes classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.		
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.		

			Semester-VIII			
Program	n	BS Chemistry	Course Code	Chem-455	<b>Credit Hours</b>	2
Course T	itle	Thermoanalytical Teo	chniques Co	urse Type	Major (Elective)	
		Co	ourse Introducti	on		
Thermal M these techn	Iethoc niques	ganized to understand th ls of Analysis: General , TGA (thermogravime nning calorimetry), T	Principle, instruttric analysis), D	umentation, A	Application, Limitat tial thermal analysis	), DSC
		Le	earning Outcom	ies		
On the con 1. 2. 3. 4.	To le Unde therr Com	on of the course, the stu earn the importance of t erstand the features rel mogravimetry, DTA and prehend the effects of t rpret the thermograms.	thermal methods lated with vario d DSC. temperature on s	of analysis. us types of	aterials.	
		Course Conte			Assignments/Rea	
Week 1		rmal Methods of Analy eral Principle	\$1\$,		Class based Learnin	ig/Test
Week 2	Instr	rumentation			Class based Learnin	ng/Test
Week 3	Insti	rumentation			Class based Learnin	ng/Test
Week 4	App	lication			Class based Learnin	ng/Test
Week 5	Lim	itations of these technic	lues		Class based Learnin	ıg/Test
Week 6	TGA	A (thermogravimetric an	nalysis)		Class based Learnin	ıg/Test
Week 7	TGA	A (thermogravimetric an	nalysis)		Class based Learnin	ıg/Test
Week 8	Mid	Term Assessment				
Week 9	DTA	A (differential thermal a	nalysis)		Class based Learnin	ıg/Test
Week 10	DTA	A (differential thermal a	nalysis)		Class based Learnin	ıg/Test
Week 11	DSC	C (differential scanning	calorimetry)		Class based Learnin	ıg/Test
Week 12	DSC	C (differential scanning	calorimetry)		Class based Learnin	ıg/Test

Week 13	TT (thermometr	ric titrations)		Class based Learning/Test		
Week 14	TT (thermometri	ric titrations)		Class based Learning/Test		
Week 15	EGD (evolved g	gas detection)		Class based Learning/Tes		
Week 16		Fi	nal Term Assessment			
		Textbooks ar	nd Reading Material			
<ol> <li>Sep</li> <li>Wr. sele</li> <li>Lar</li> <li>Lar</li> <li>Šes</li> <li>ICT 284</li> <li>Sko</li> </ol>	ight, A. S., Colen ected corresponde ne, G. A., & Lane Boca Raton, FL, ták, J., Hubík, P., CAC and CALCO 8-7. bog, D. A., Holler mont: Brooks/Co Lecturing using Written Assignm Class activities a Quiz about last I Class Presentation	han, D., & Kaise ence of Sidney C , G. A. (Eds.). (1 USA. Mareš, J. J., & N societies. Jour F, F. J., & Crouch le, Cengage Lea <b>Teaching L</b> white/black boa nents/presentation and Discussion lecture ons Audio/visua <b>nments: Types</b>	r, D. (2023). Theoretica oleman. 983). Solar heat storage Holba, P. (2013). Histor rnal of Thermal Analysi h, S. R. (2007). Instrume rning. earning Strategies rd/Multimedia ons/ Task related to assi 1 Aids/ Tutorials and Number with Cale	e: latent heat materials (Vol. cy of thermal analysis and is and Calorimetry, 12, ental analysis (Vol. 47).		
	Assignments, qu	iiz, Tasks, Prese	ntation etc.			
			ssessment			
<b>Sr. No.</b> 1.	Elements Midterm Assessment	Weightage 35%	Written Assessmen	<b>Details</b> nt at the mid-point of the emester.		
2.	Formative Assessment	25%	Continuous assess participation, assign voce, attitude and bel short tests, project	ment includes classroom ments, presentations, viva havior, hands-on-activities, ts, practical, reflections, s, quizzes etc.		
3.	Final Assessment	40%	It is mostly in the form nature of the course to students based on ter	at the end of the semester. n of a test, but owing to the he teacher may assess their m paper, research proposal york and report writing etc.		

		Semester	·-VIII			
Program	m BS Chemistry	Course Code	Chem-456		Credit Hours	1
Course T	itle Thermoanalytical Te	echniques (L	ab) Course Typ	)e	Major (Elec	tive)
		Course Intro	oduction			
The course	e is designed to analyze var	ious samples	by Thermal analys	is met	hods.	
	ermogravimetric analysis o		alate			
	G and DTG analysis of poly	0				
	G and DTG analysis of poly					
	etermination of thermal stab		-			
	etermination of carbon blach ΓA analysis of biomass/plar		poxy sample			
	etermination of purity/mel		banzoic acid/ova	lic ac	id/nonhtholong	usino
U DC		ing point of	belizoie acid/oxa	ine ac	id/naphthalene	using
		Learning O	utcomes			
On the con	mpletion of the course, the	U				
1.	Perform thermogravimetr	ic analyses of	f samples.			
2.	Interpret thermograms of					
3.	Understand the effect of te		n stability of materi			
	Course Co				signments/Re	adings
Week 1	Thermogravimetric analy	sis of calciun	um oxalate		b based	
					rformance/Lab	)
Week 2	Thermogravimetric analy	reis of calcium	n ovalate		borts b based	
WEEK 2			ii Oxalate		rformance/Lab	)
					orts	
				1		
Week 3	TG and DTG analysis of	polymer gels		La	b based	
				Pe	rformance/Lab	)
				-	ports	
Week 4	TG and DTG analysis of	polymer gels			b based	
					rformance/Lab ports	)
Week 5	Determination of thermal	stability of a	given compound		b based	
		u	o		rformance/Lab	)
				rep	oorts	
Week 6	Determination of thermal	stability of a	given compound		b based	
					rformance/Lab	)
***		. 1 . 1	• •	-	ports	
Week 7	Determination of thermal	stability of a	given compound		b based rformance/Lab	
					orts	)
Week 8	MID TERM ASSESSME	INT			0110	
Week 9	Determination of carbon	black content	in epoxy sample		b based	
					rformance/Lab	)
				rep	oorts	

Week 10	Determination of carbon black content in epoxy sample	Lab based Performance/Lab reports
Week 11	DTA analysis of biomass/plant materials	Lab based Performance/Lab reports
Week 12	DTA analysis of biomass/plant materials	Lab based Performance/Lab reports
Week 13	Determination of purity/melting point of benzoic acid/oxalic acid/naphthalene using DTA	Lab based Performance/Lab reports
Week 14	Determination of purity/melting point of benzoic acid/oxalic acid/naphthalene using DTA	Lab based Performance/Lab reports
Week 15	Determination of purity/melting point of benzoic acid/oxalic acid/naphthalene using DTA	Lab based Performance/Lab reports
Week 16	FINAL TERM ASSESSMEN	Г
	Textbooks and Reading Material	
<ol> <li>Sep</li> <li>Wr</li> <li>sele</li> <li>Lar</li> <li>Lar</li> <li>Šes</li> <li>ICT</li> <li>Sko</li> </ol>	nded Books: be, M. P. (1997). Thermal analysis of polymers (Vol. 95). S ight, A. S., Coleman, D., & Kaiser, D. (2023). Theoretical p ected correspondence of Sidney Coleman. he, G. A., & Lane, G. A. (Eds.). (1983). Solar heat storage: Boca Raton, FL, USA. ták, J., Hubík, P., Mareš, J. J., & Holba, P. (2013). History FAC and CALCON societies. Journal of Thermal Analysis bog, D. A., Holler, F. J., & Crouch, S. R. (2007). Instrument mont: Brooks/Cole, Cengage Learning.	ohysics in your face: latent heat materials (Vol. of thermal analysis and and Calorimetry, 12, 2848-
	Teaching Learning Strategies	
• • • •	Lecturing using white/black board/Multimedia Written Assignments/presentations/ Task related to assign Class activities and Discussion Quiz about last lecture Class Presentations Audio/visual Aids/ Tutorials Laboratory performance	ed topics
	Assignments: Types and Number with Caler	ıdar
	Assignments, quiz, Tasks, Presentation etc.	

_	Assessment			
Sr. No.	Elements	Weightage	Details	
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.	
2.	Formative Assessment	25%	Continuous assessment includes classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.	
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.	

		Semester-VIII			
Program	n BS Chemistry	Course Code	Chem-457	<b>Credit Hours</b>	2
Course Ti	tle Environmental Chemistry	Course Ty	pe Major (l	Elective)	
		Course Introductio			
impact of n Analytical pollutants i threshold v Environmer ozone che Pollutants hazardous o sources of Water cont of nitrogen fertilizer pl fertilizers o and conser	e is organized to understand nodern life. Techniques for pollutant n aqueous system like PCI alues by US-EPA, ASTM, ntal Pollution: Environment mistry: Ozone depletion (Sulfur dioxide, nitrogen of effects, losses of methane a methane, or sinks of me amination and hazardous of n, Sulphur and Phosphor ant effluent discharges, effor on environment, suggestion vation of soil, leaching of the accumulation. Public award	t Analysis: Techn B, PAH, THM, HA Pak-EPA. ntal pollution in the and its biochem oxide, chlorofluoro and ammonia from othane. Atmospheri effects of pesticide us based fertilized fect and fate of nit for controlling adv fertilizers into soil,	iques for the A, Guideline e world and in ical effect, ( paddyland pr c changes an s, herbicides a rs on environ rogen, Sulphu verse effects o factors affect	e analysis of em s, Parameters, MC n Pakistan, Oxyge Greenhouse effec of sources/discharg oduction system, d sources of amr and insecticides. If ament. Compositi r and Phosphorus f fertilizer plant ef ing nitrate, sulpha	erging L and en and t, Air ge and global nonia. Effects on of based ffluent te and
	nd prevention.	Learning Outcome		6	
1. Lea 2. Kno	pletion of the course, the s rn the significance of envir ow the impact of modern lin nprehend the industrial and	onmental degradat fe on environmenta	ion		
01 001	Course Content		Assi	gnments/Reading	gs
Week 1	Analytical Techniques for Techniques for the analys pollutants in aqueous syst THM, HAA	r pollutant Analysis is of emerging	, Class bas	sed Learning/Test	
Week 2	Guidelines, Parameters, N values by US-EPA, ASTN		Class bas	sed Learning/Test	
Week 3	Environmental Pollution, Environmental pollution i Pakistan	in the world and in	Class bas	sed Learning/Test	
Week 4	Oxygen and ozone chemi and its biochemical effect		on Class bas	sed Learning/Test	
Week 5	Greenhouse effect, Air Po dioxide, nitrogen oxide, c etc.,), sources/discharge a losses of methane and am	hlorofluorocarbons and hazardous effect monia from	s ts	sed Learning/Test	
Week 6	paddyland production sys	tem, global source	s Class	based Learning/T	est
	of methane, or sinks of m	ethane			

Week 8	Week 8     Mid Term Assessment					
Week 9	Water contamination and hazardous effects of pesticides, herbicides and insecticides	Class based Learning/Test				
Week 10	Effects of nitrogen, Sulphur and Phosphorus based fertilizers on environment	Class based Learning/Test				
Week 11	Composition of fertilizer plant effluent discharges, effect and fate of nitrogen	Class based Learning/Test				
Week 12	Sulphur and Phosphorus based fertilizers on environment	Class based Learning/Test				
Week 13	ek 13Suggestions for controlling adverse effects of fertilizer plant effluent and conservation of soil, leaching of fertilizers into soilClass based Learning/Test					
Week 14	Eactors affecting nitrate sulphate and					
Week 15	Public awareness: Improper disposal/dumping of hazardous waste of landfills, and prevention	Class based Learning/Test				
Week 16   Final Term Assessment						
Textbooks and Reading Material						
<ol> <li>Recommended Books:         <ol> <li>Harrison, R. M. (2007). Biogeochemical cycling of chemicals. Principles of environmental chemistry,</li> <li>De Anil, K. (2003). Environmental chemistry. New Age International.</li> <li>Moore, J. (2012). Environmental chemistry.</li> <li>Manahan, S. E. (2022). Environmental chemistry.</li> <li>Radojevic, M., &amp; Bashkin, V. N. (1999). Practical environmental analysis.</li> <li>Sparks, D. L., Singh, B., &amp; Siebecker, M. G. (2022). Environmental soil chemistry.</li> </ol> </li> </ol>						
Teaching Learning Strategies						
<ul> <li>Lecturing using white/black board/Multimedia</li> <li>Written Assignments/presentations/ Task related to assigned topics</li> <li>Class activities and Discussion</li> <li>Quiz about last lecture</li> <li>Class Presentations Audio/visual Aids/ Tutorials</li> </ul>						
	Assignments: Types and Number with Calendar					
Assignments, quiz, Tasks, Presentation etc.						

	Assessment				
Sr. No.	Elements	Weightage	Details		
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.		
2.	Formative Assessment	25%	Continuous assessment includes classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.		
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.		

			Semester-VII	[		
Program	m BS C	Chemistry	Course Code	Chem-458	Credit Hours	1
Course Title Environmental Analysi		sis (Lab)	Course Type	Major (Elective)		
		Co	ourse Introduct	ion		
Determina Determina Determina wastewate Determina Determina Determina	tion of chlo tion of cher tion of bioc tion of To r sample tion of nitro tion of chro tion of sulp tion of poly npletion of 1. Learn 2. Have h	d to understand the orides in aqueous s mical oxygen dema chemical oxygen d otal suspended so ogen by Kjeldahl r omium in wastewate varomatic hydrocar Le the course, the stu the significance of aands-on experience	e significance of olution and (COD) of w emand (BOD) o olids, Total dis nethod ter samples er samples toons (PAHs) <b>carning Outcon</b> dents will be ab	r environmental astewater samp f wastewater sa solved salts a solved salts a nes le to: analysis.	le	_
	aqueou	is systems.	ont		A ssignmonts/Doo	dinge
Week 1		Course Cont	ent		Assignments/Rea	aings
Week 2	Determination of chlorides in aqueous solution.			Performance/Lab reports Lab based Performance/Lab		
Week 3	Week 3         Determination of chemical oxygen demand (COD) of wastewater sample		(COD) of	reports Lab based Performance/Lab reports		
Week 4	Veek 4 Determination of chemical oxygen demand (COD) of wastewater sample			(COD) of	Lab based Performance/Lab reports	
Week 5	Week 5Determination of biochemical oxygen demand (BOD) of wastewater sample			and (BOD) of	Lab based Performance/Lab reports	
Week 6	Week 6Determination of biochemical oxygen demand (BOD) of wastewater sample			und (BOD) of	Lab based Performance/Lab reports	
Week 7	Week 7Determination of Total suspended solids, Total dissolved salts and conductance of the wastewater sample			Lab based Performance/Lab reports		
Week 8	MID TER	RM ASSESSMEN	Т		-	
Week 9	eek 9 Determination of nitrogen by Kjeldahl method		od	Lab based Performance/Lab reports		

Week 10	Determination of nitrogen by Kjeldahl method	Lab based
WCCK IU	Determination of introgen by Reidam method	Performance/Lab
		reports
Week 11	Determination of chromium in wastewater samples	Lab based
		Performance/Lab
		reports
Week 12	Determination of chromium in wastewater samples	Lab based
	1	Performance/Lab
		reports
Week 13	Determination of sulphates in wastewater samples	Lab based
		Performance/Lab
		reports
Week 14	Determination of sulphates in wastewater samples	Lab based
		Performance/Lab
		reports
Week 15	Determination of polyaromatic hydrocarbons (PAHs)	Lab based
		Performance/Lab
		reports
Week 16	FINAL TERM ASSESSMEN	Г
	Textbooks and Reading Material	
Recomme	nded Books:	
	De Anil, K. (2003). Environmental chemistry. New Age I	nternational.
	Manahan, S. E. (2011). Fundamentals of environmental cl	
	Manahan, S. E. (2022). Environmental chemistry.	2
4.	Radojevic, M., & Bashkin, V. N. (1999). Practical environ	nmental analysis.
5.	Sparks, D. L., Singh, B., & Siebecker, M. G. (2022). Envi	
	Teaching Learning Strategies	
•	Lecturing using white/black board/Multimedia	
•	Written Assignments/presentations/ Task related to assig	ned topics
•	Class activities and Discussion	
•	Quiz about last lecture	
•	Class Presentations Audio/visual Aids/ Tutorials	
•	Laboratory performance	
	Assignments: Types and Number with Cale	ndar
	Assignments, quiz, Tasks, Presentation etc.	
	<b>C</b> , <b>1</b> , , , , , , , , , , , , , , , , , , ,	

	Assessment				
Sr. No.	Elements	Weightage	Details		
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.		
2.	Formative Assessment	25%	Continuous assessment includes classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.		
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.		

	Semester-VIII					
Program	BS Chemistry Course Code		Chem- 459	Credit Hours	3	
Course Ti	itle Compound and Molecular Specific Analysis-II			pe Major (Electiv	e)	
		Course Introdu	ction			
techniques Nuclear M shifts; Spi	lagnetic Resonance Spec n-Spin coupling; Pulsed features; Use of NMR	troscopy: Basic p Fourier Transfor	rinciples; pr m NMR Sp	operties of nuclei, C ectrometry; Identific	Chemical ation of	
ionization application	ctrometry: Principle, san source, mass analyzers, d s, confirmation of synthe l mass-spectrometric tech	etections system, esis products, isot	qualitative a	nalysis, quantitative	analysis,	
	1	Learning Outco	mes			
2. 3.	<ul> <li>On the completion of the course, the students will be able to: <ol> <li>Have knowledge about the advanced spectroscopic techniques.</li> <li>Learn the advanced structural elucidation techniques.</li> <li>Determine the structure of various molecules on the basis of their NMR and mass spectrometric data.</li> <li>Use the laser spectroscopy for the purpose of analysis will also be studied in this course.</li> </ol></li></ul>					
	Course C	Content		Assignments/R	eadings	
Week 1	Nuclear Magnetic Reso principles	onance Spectrosco	opy, Basic	Class based Learning/Test		
Week 2	Properties of nuclei			Class based Learning/Test		
Week 3	Chemical shifts; Spin-Sp	1 0		Class based Learning/Test		
Week 4	Pulsed Fourier Transform	•	etry	Class based Learning/Test		
Week 5	eek 5         Identification of structural features			Class based Learning/Test		
Week 6	6 Use of NMR imaging in medicine			Class based Learning/Test		
Week 7	Analytical applications of NMR spectroscopy			Class based Learning/Test		
Week 8						
Week 9	Mass Spectrometry, Principle, sample for mass spectrometer,			Class based Learning/Test		
Week 10	Sample introduction system, ionization source			Class based Learning/Test		
Week 11	Mass analyzers, Detections system			Class based Learning/Test		

		• .•	1 1 1		
Week 12	Qualitative analysis, quantitative analysis, applications			Class based	
		Learning/Test			
Week 13	Confirmation of	synthesis produc	cts	Class based	
		Learning/Test			
Week 14	Isotopes incorpo	ration		Class based	
				Learning/Test	
Week 15	Structure elucida	tion hyphenate	d mass-spectrometric	Class based	
WEEK IS	techniques	uton, nyphenates	a mass speed one are	Learning/Test	
	teeninques		1	Learning/Test	
Week 16			nal Term Assessment		
			nd Reading Material		
	-		MR spectroscopy through	h method and software	
	-	Springer Nature			
			. R. (2022). A Graduate C	ourse in NMR	
	Spectroscopy				
		Hitchens, T. K.	. (2001). Protein NMR spe	ectroscopy. Mod. Protein	
	Chem. Pract.				
	4. Cole, L. M., &	& Cole. (2017). I	maging mass spectrometr	у.	
	5. Lee, Y. J. (Ed	.). (2022). Mass	Spectrometry Imaging of	Small Molecules.	
	Humana Pres	S.			
	6. Gross, J. H. (2	2006). Mass spec	ctrometry: a textbook. Spr	inger Science & Business	
	Media.	/ I	<b>,</b> 1	5	
		<b>Teaching L</b>	earning Strategies		
•	Lecturing using	0	0 0		
•	0 0				
•	0	-	ns/ Task related to assigned	ed topics	
•	Class activities a				
•	Quiz about last l				
•	Class Presentation	ons Audio/visual	Aids/ Tutorials		
	Assig	nments: Types	and Number with Calen	dar	
	Assignments, qu	iz, Tasks, Preser	ntation etc.		
		As	ssessment		
Sr. No. Elements Weightage Details				tails	
	Midterm		Written Assessment	at the mid-point of the	
1.	Assessment	35%		ester.	
	10000011011				
Continuous assessment includes classroom           participation, assignments, presentations, viv					
2	Formative	250/			
2.	Assessment	25%		vior, hands-on-activities,	
			1 0	practical, reflections,	
			readings, o	quizzes etc.	
			Written Examination at	t the end of the semester.	
				of a test, but owing to the	
2	Final	400/	-	-	
3.	Final Assessment	40%	nature of the course the	teacher may assess their	
3.		40%	nature of the course the students based on term	teacher may assess their paper, research proposal	
3.		40%	nature of the course the students based on term	teacher may assess their	