## School of Chemistry Faculty of Science University of the Punjab, Lahore Course Outline



BS Chemistry Semester-V							
Programme		<b>BS</b> Chemistry	Course Code	Chem-391	l	<b>Credit Hours</b>	2
<b>Course Title</b>		Introduction to Gre	en Solvents	Course Ty	ype	Major Elect	ive
	Course Introduction						
This course is aimed to make students learn about green solvents essential for any of the chemical reaction to make it environmentally benign. It explores the principles, applications and environmental impacts of green solvents in chemical processes. Introduction to green solvents, traditional solvents and their impact, traditional vs green solvents, solvent selection and evaluation, types of green solvents, water, supercritical fluids, ionic liquids & deep eutectic mixtures, physiochemical properties of green solvents, nomenclature of ionic liquids, synthesis of ionic liquids, applications of green solvents in organic synthesis and industrial processes.							
		Ι	Learning Outcom	ies			
<ul> <li>On the completion of the course, the students will be able to:</li> <li>1. Understand the principles of green chemistry and solvent selection</li> <li>2. Explore various types of green solvents and their applications</li> <li>3. Evaluate the environment and economic impact of traditional vs green solvents</li> <li>4. Explore the applications of green solvents in various lab scale processes</li> </ul>							
Course Content Assignments/Read					ings		
Week 1	Intr	oduction to green solv	vents	]	Related reading		
Week 2	Tra	ditional solvents and t	heir impact	]	Related reading		
Week 3	Traditional vs. green solvents				Related reading		
Week 4	Solvent selection and evaluation				Related reading		
Week 5	Types of green solvents			]	Related reading		
Week 6	Water and supercritical fluids as green solvents			ents ]	Relat	ted reading	
Week 7	Ionic liquids and deep eutectic mixtures as green solvents       Related reading						
Week 8	Mid-term Examination						
Week 9	Physiochemical properties of green solvents			s ]	Relat	ted reading	
Week 10	Types and nomenclature of ionic liquids			]	Related reading		
Week 11	Synthesis of ionic liquids R			Related reading			
Week 12	Task specific ionic liquids and their significance			Related reading			
Week 13	Applications of green solvents in organic synthesis Related reading				ted reading		

Week 14	Applications of green solvents in industrial processes			Related reading		
Week 15	Challenges and	future direction	S	Related reading		
Week 16	Fina	al term Examin	ation			
		Textbooks an	nd Reading Material			
Perspective RSC Publ 2. A. Lapl Sustainab 3. Dougla Liquids, fri 4. Michea 5. Jason P 6. Suojian Elsevier P 7. P. Ana Designing Class lect visual too 1. W 2. Pro 3. Tu	ves from Researce ishers. kin and D. Consta le Processes, Wile s, R. Macfarlane, com Chemistry to l Freementle, (20 . Hallett. (2010), A g Zhang, Xinmei bublishers stas and P. Trev <u>a Safer Chemicals</u> cure method, whice ls will be used wh <u>Assig</u> ritten Task esentation ttorials	<i>h, Business and</i> able, (2008), <i>Grower</i> y Publishers. Mega Kar, and <i>Applications</i> , W 10), <i>An Introduce</i> <i>An Introduction</i> Lu, Sucai Li. (2 orrow, (2013), Wiley Publisher <b>Teaching L</b> th includes seminatere necessary <b>ments: Types</b>	d International Policy een Chemistry Metrics Jennifer M. Pringle, (2 filey VCH publishers. tion to Ionic Liquids, H to Ionic Liquids, RSC 009), Ionic Liquids: Pl Handbook of Green C ers cearning Strategies	Publishers. hysicochemical Properties, Chemistry, Green Processes, gnments and projects. Audio-		
4. Solving related exercises Assessment						
Sn No	Flomonts	· · · · · · · · · · · · · · · · · · ·		Dataila		
Sr. No.           1.           2.	ElementsMidtermAssessmentFormativeAssessment	Weightage 35% 25%	semester. Continuous assessm participation, assign voce, attitude and b	nments, presentations, viva ehavior, hands-on-activities, cts, practical, reflections,		
3.	Final Assessment	al 40% Written Examination at the end of the semester				

BS Chemistry Semester-V							
Program	ne B	BS Chemistry Course Code Chem-		Chem-39	2	<b>Credit Hours</b>	1
Course Title Green Solvents Lab				Course T	ype	Major Elect	tive
	Course Introduction						
essential for principles, Synthesis of	or any of t application of green se	d to make stude the chemical reac ns and environme olvents, Solvent mical processes, o	tion to make it ental impacts of gevaluation traditi	environmen reen solven onal vs gre	tally b ts in c en so	benign. It exploi hemical process lvents, applicati	res the ses.
		L	earning Outcom	nes			
1. Uno 2. Exp 3. Eva	<ul> <li>On the completion of the course, the students will be able to:</li> <li>1. Understand the principles of green chemistry and solvent selection</li> <li>2. Explore various types of green solvents and their applications</li> <li>3. Evaluate the environment and economic impact of traditional vs green solvents</li> <li>4. Explore the applications of green solvents in various lab scale processes</li> </ul>						
		<b>Course Conte</b>	ent		Ass	signments/Read	ings
Week 1	Tools an	d techniques for g	green solvent sele	ction	Relat	ed reading	
Week 2	Using water as solvent for organic reaction (oxidation/reduction/Diels-Alder reaction /any suitable reaction)				Related reading		
Week 3	Using water as solvent for organic reaction (oxidation/reduction/Diels-Alder reaction /any suitable reaction)				Relat	ed reading	
Week 4	Using water as solvent for organic reaction (oxidation/reduction/Diels-Alder reaction /any suitable reaction) Related reading				ed reading		
Week 5	Synthesis of acidic ionic liquid				Relat	ed reading	
Week 6	Synthesis of basic ionic liquid				Related reading		
Week 7	Synthesis of room temperature ionic liquid				Related reading		
Week 8	Mid-term Examination						
Week 9	Synthesis of deep eutectic solvents				Related reading		
Week 10	Synthesis of deep eutectic solvents				Related reading		
Week 11	Organic synthesis using ionic liquids (Wittig reaction/Friedel Crafts/Diels-Alder/reduction reaction)			on	Related reading		
Week 12	Organic synthesis using ionic liquids (Wittig reaction/Friedel Crafts/Diels-Alder/reduction reaction)			on	Related reading		
Week 13	Organic synthesis using ionic liquids (Wittig reaction/Friedel Crafts/Diels-Alder/reduction reaction)					ed reading	

Textbooks and Reading Material					
Week 16	Final term Examination				
Week 15	Dissolution of cellulose using ionic liquids	Related reading			
Week 14	Organic synthesis using ionic liquids (Wittig reaction/Friedel Crafts/Diels-Alder/reduction reaction)	Related reading			

1. J. H. Clark, A. Hunt, C. Topi, G. Paggiola and J. Sherwood, (2017), *Sustainable Solvents: Perspectives from Research, Business and International Policy (Green Chemistry Series),* RSC Publishers.

2. A. Lapkin and D. Constable, (2008), *Green Chemistry Metrics: Measuring and Monitoring Sustainable Processes*, Wiley Publishers.

3. Douglas, R. Macfarlane, Mega Kar, and Jennifer M. Pringle, (2017), *Fundamentals of Ionic Liquids, from Chemistry to Applications*, Wiley VCH publishers.

4. Micheal Freementle, (2010), An Introduction to Ionic Liquids, RSC Publishers.

5. Jason P. Hallett. (2010), An Introduction to Ionic Liquids, RSC Publishers.

6. Suojiang Zhang, Xinmei Lu, Sucai Li. (2009), *Ionic Liquids: Physicochemical Properties*, Elsevier Publishers

7. P. Anastas and P. Trevorrow, (2013), *Handbook of Green Chemistry, Green Processes, Designing Safer Chemicals*, Wiley Publishers

## **Teaching Learning Strategies**

Class lecture method, which includes seminars, discussions, assignments and projects. Audiovisual tools will be used where necessary

## Assignments: Types and Number with Calendar

- 1. Written Task
- 2. Presentation
- 3. Tutorials
- 4. Solving related exercises

	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.			