



ARSD College, University of Delhi

Model Course Handout/Lesson Plan

Course Name : B.Sc. (Hons.) Chemistry						
Semester	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
VI	557	Organic Chemistry-V : Spectroscopy and applied organic chemistry	60		60	6
Teacher/Instructor(s)		Dr. Sangita Aggarwal				
Session		2022-23				

Course Objective: The course introduces the learner to various tools and techniques for identifying and characterizing the organic compounds through their interactions with electromagnetic radiation viz. UV-Visible, IR and NMR spectroscopy. This course also deals with some classes of organic compounds finding applications in everyday life namely; polymers, dyes, and pharmaceutical compounds. The chemistry of these compounds in general will be explained through naturally occurring and synthetic compounds.

Course Learning Outcomes:

On completion of this course, the students will be able to:

- Gain insight into the basic principles of UV, IR and NMR spectroscopic techniques.
- Use spectroscopic techniques to determine structure and stereochemistry of known and unknown compounds.
- Develop a sound understanding of the structure of Pharmaceutical Compounds. They will also understand the importance of different classes of drugs and their applications for treatment of various diseases.
- Learn about the chemistry of natural and synthetic polymers including fabrics and rubbers.
- Understand the chemistry of biodegradable and conducting polymers and appreciate the need of biodegradable polymers with emphasis on basic principles.
- Learn about the theory of colour and constitution as well as the chemistry of dyeing.
- Know applications of various types of dyes including those in foods and textiles.

Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	Organic Spectroscopy	1 and 2	General principles, Introduction to absorption and emission spectroscopy

	UV Spectroscopy:	3 and 4	Types of electronic transitions, λ_{\max} , Lambert-Beer law, Chromophores and Auxochromes, Bathochromic and hypsochromic shifts,
		5 and 6	Intensity of absorption; Application of Woodward Rules for calculation of λ_{\max} for the following systems: Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems along with problems
		7 and 8	α,β -unsaturated aldehydes, ketones, carboxylic acids and esters; (aldehydes, ketones and dienes); discuss problem based on above
		9 and 10	Distinction between cis and trans isomers by UV. Aromatic system,
	IR Spectroscopy:	11 and 12	Basics of IR, Fundamental and non-fundamental molecular vibrations;
		13 and 14	IR absorption positions of O, N and S containing functional groups; Effect of H-bonding,
		15, 16 and 17	conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application of IR in functional group analysis.
		18	Class test based on UV and IR spectroscopy
	NMR Spectroscopy:	19-20	Basic principles of Proton Magnetic Resonance, Equivalent and non-equivalent protons
		21-22	Equivalent and non-equivalent protons, chemical shift and factors influencing it,;
		23-24	Spin — Spin coupling and coupling constant
		25-26	Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.
		27-28	Applications of IR, UV and NMR for identification of simple organic molecules
		29-30	Class test and problem discussion
2.	Dyes	31-32	Classification, Colour and constitution; Chemistry of dyeing.
		33-34	Mordant and Vat Dyes; Synthesis and applications of Azo dyes - Methyl orange, Congo red;
		35-36	Triphenyl methane dyes-Malachite green, Rosaniline and Crystal violet; Phthalein Dyes — Phenolphthalein;

		37-38	Natural dyes -Structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.
3.	Pharmaceutical Compounds	39-40	Classification, structure and therapeutic uses of antipyretics - Paracetamol (with synthesis);
		41-42	Analgesics- Ibuprofen (with synthesis); Antimalarials - Chloroquine (with synthesis); Antitubercular drugs - Isoniazid.
		43-44	An elementary treatment of Antibiotics and detailed study of chloramphenicol,
		45-46	Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).
		47-48	Discuss problems and a class test
4.	Polymers	49-50	Introduction and classification including di-block, tri-block and amphiphilic polymers; weight average molecular weight, number average molecular weight,
		50-51	glass transition temperature (T _g) of polymers; Polymerisation reactions - Addition and condensation.
		52-53	Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes.
		54-55	Preparation and applications of plastics - thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics - natural and synthetic (acrylic, polyamide, polyester).

		56-57	Rubbers – natural and synthetic, Buna-S, Chloroprene and Neoprene. Vulcanization - Polymer additives;
		58-59	Introduction to Biodegradable and conducting polymers with examples.
		60	Discuss problems

Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment		Internal assessment will be given based on class test and participation in problem discussion.
			25
	• Quiz		
	• Class Test		1 hour each
	• Attendance		Out of total lectures
	• Assignment		Class notes
2.	End Semester Examination	3 hr	75

Details of the Course		
Unit	Contents	Contact Hours
1.	<p>Organic Spectroscopy</p> <p>General principles Introduction to absorption and emission spectroscopy.</p> <p>UV Spectroscopy: Types of electronic transitions, λ_{\max}, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ_{\max} for the following systems: α,β-unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers by UV.</p> <p>IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application of IR in functional group analysis.</p> <p>NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Equivalent and non-equivalent protons, Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple</p>	30

	compounds. Applications of IR, UV and NMR for identification of simple organic molecules.	
2.	<p style="text-align: center;">Dyes</p> <p>Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing.</p> <p>Synthesis and applications of Azo dyes - Methyl orange, Congo red; Triphenyl methane dyes-Malachite green, Rosaniline and Crystal violet; Phthalein Dyes - Phenolphthalein; Natural dyes -Structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.</p>	8
3.	<p style="text-align: center;">Pharmaceutical Compounds</p> <p>Classification, structure and therapeutic uses of antipyretics - Paracetamol (with synthesis); Analgesics-Ibuprofen (with synthesis); Antimalarials - Chloroquine (with synthesis); Antitubercular drugs - Isoniazid. An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).</p>	10
4.	<p style="text-align: center;">Polymers</p> <p>Introduction and classification including di-block, tri-block and amphiphilic polymers; weight average molecular weight, number average molecular weight, glass transition temperature (T_g) of polymers; Polymerisation reactions -Addition and condensation. Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes. Preparation and applications of plastics - thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics - natural and synthetic (acrylic, polyamide, polyester). Rubbers - natural and synthetic, Buna-S, Chloroprene and Neoprene. Vulcanization - Polymer additives; Introduction to Biodegradable and conducting polymers with examples.</p>	12
	Total	60
Suggested Books:		
Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Pavia, D.L. Introduction to Spectroscopy , Cengage learning (India) Pvt. Ltd.	2006
2.	Morrison, R. T.; Boyd, R. N. Organic Chemistry , Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	2009

3.	Solomons, T.W.G. (2017), Organic Chemistry , John Wiley & Sons.	2017
4.	Kemp, W. (1991), Organic Spectroscopy , Palgrave Macmillan	1991
5.	Silverstein, R.M.; Webster, F.X.; Kiemle, D.J.; Bryce, D.L. (2014), Spectrometric Identification of Organic Compounds , Wiley.	2014
Mode of Evaluation:		Internal Assessment / End Semester Exam