DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE 01)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Introduction to Heterocyclic Chemistry; ALS CHEM DSE 01	**4**	**2**	**0**	**2**	**XII pass with Science with Biology/ Biotechnology**	**NIL**

Learning Objectives:

The Learning objectives of this course are as follows:

- To teach students the fundamentals of heterocyclic chemistry.
- To make them familiar with classification and nomenclature of heterocyclic compounds.
- To study structural characteristics, physical properties, synthesis and chemical reactions of heterocyclic compounds.
- To know the importance of heterocyclic compounds.

Learning Outcomes:

By studying this course, students will be able to:

- Classify and name heterocyclic compounds.
- Analyze the important synthetic routes, physical properties, chemical properties and reactivity of five and six membered heterocyclic compounds.
- Explain the heterocyclic structures in biologically active compounds.
- Apply the study of heterocyclic compounds in medicine, agrochemicals, dyes and pigments, plastics and polymers.

Unit 1: Introduction and Nomenclature (4 Hours)

Introduction and classification of heterocyclic compounds. Nomenclature: Trivial names of common ring systems, Systematic (Hantzsch-Widman) nomenclature for heterocyclic compounds, naming of fused ring systems and Replacement nomenclature.

Unit 2: General Properties and Synthesis of Five and Six Membered Heterocyclic Compounds (8 Hours)

General discussion on the following aspects of five and six membered heterocyclic compounds containing one heteroatom: Structure, aromaticity, basicity, physical properties and general methods of synthesis of Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene and Pyridine (Hantzsch synthesis).

Unit 3: Reactions of Five and Six Membered Heterocyclic Compounds (10 Hours)

Furan, Pyrrole, Thiophene: Orientation and reactivity towards electrophilic substitution reactions with mechanism.
Discussion on the following reactions: Nitration, sulphonation, halogenation, formylation, acylation, mercuration and carboxylation. Reactions exhibiting acidic/basic character. Oxidation, reduction and addition reactions. Diels-Alder reaction, reaction with diazonium salt.
Pyridine: Electrophilic substitution, nucleophilic substitution, oxidation and reduction reactions.

Unit 4: Importance of Heterocyclic Compounds (8 Hours)

Structure and importance of the following selected biologically active compounds to be discussed:
Heterocyclic Amino Acids: Proline, Hydroxyproline, Histidine, Tryptophan. Heterocyclic Vitamins; Niacin (Vitamin B3), Pyridoxine (Vitamin B6), Riboflavin (Vitamin B2), Thiamin (Vitamin B1) and Ascorbic acid (Vitamin C).
Pigments of Life: Hemoglobin and Chlorophyll.
Nucleic acids: Ribonucleic Acid (RNA) and Deoxyribonucleic Acid (DNA), Purines and Pyrimidines.

Structure and importance of the following selected Natural Products**:** Alkaloids, Marine Heterocycles, Halogenated Heterocycles, Macrocycles containing Oxazoles and Thiazoles, Anthocyanins and Flavones.

Structure and importance of heterocyclic compounds in Medicine, Agrochemicals, Dyes and pigments, Plastics and polymers.

PRACTICAL (Credit: 02)

(Laboratory practical- 15 classes of 4 hours each)

The following synthesis should be done by using 0.5-1 g of the organic compound. The solid samples must be collected and may be used for recrystallization and melting point.

1. Synthesis of oxygen containing heterocyclic compounds:
   (a) Phthalic anhydride (b) 7- Hydroxy-4-methylcoumarin

2. Synthesis of nitrogen containing heterocyclic compounds:
   (a) Phthalimide (b) Phthaloylglycine
3. Synthesis of Imidazole derivatives:
   (a) Benzimidazole (b) 2-Benzylbenzimidazole (c) 2-Methylbenzimidazole
4. Synthesis of Pyrazole derivatives:
   (a) 3-Methyl-2-pyrazolin-5-one (b) 3, 5-Dimethylpyrazole
5. Synthesis of Pseudothiohydantoin

Essential/Recommended readings

1. Mehta Bhupinder and Mehta Manju (2015) "*Organic Chemistry" 2nd Edn*., PHI Learning Pvt. Ltd. New Delhi. ISBN-978-81-203-5126-4.
2. Bansal Raj K "*Heterocyclic Chemistry" 5th Ed*, New Age International Publishers. ISBN 978-81-224-3143-8.
3. J. A. Joule, K. Mills and G. F. Smith, "*Heterocyclic Chemistry" 5th Edn.,* Wiley International Publications. ISBN: 978-1-4051-3300-5.
4. Thomas. L. Gilchrist "*Heterocyclic Chemistry" 3rd Edn.*, Prentice Hall Publication. ISBN 978-0-5822-7843-1.
5. R. M. Acheson "*An Introduction to the Chemistry of Heterocyclic compounds" 3rd Edn.,* Wiley India Pvt. Ltd. ISBN-13:978-8126516605.
6. I L Finar, "*Organic Chemistry" Vol. 1*, 6th Edn., Pearson Education. ISBN 10: 8177585428.
7. T. W. Graham Solomons, "*Organic Chemistry*" 12th Edn., John Wiley. ISBN-10: 1118133579.
8. Parashar, R. K.; Negi, B., "*Chemistry of Heterocyclic Compounds"*, 2015, Ane Books. ISBN-1466517131.

Suggestive readings

1. A.O. Fitton and R.K. Smalley, "*Practical Heterocyclic Chemistry"* 1st Edn., Academic Press. ISBN:9781483270791.

2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), "*Vogel's Textbook of Practical Organic Chemistry"*, Pearson.

3. Mann, F.G.; Saunders, B.C. (2009), "*Practical Organic Chemistry*", Pearson.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.