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CHEMISTRY COMPONENT - DSE

DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE 02)

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
		Lecture	Tutorial	Practical/ Practice		
Organic Chemistry in Pesticide Synthesis ALS CHEM DSE 02	**4**	**2**	**0**	**2**	**Class 12th Pass with Science**	**NIL**

Learning Objectives:

The Learning objectives of this course are as follows:

- to familiarize students to different types of classification of pesticides.
- to familiarize with factors that make the organic compound to be considered as pesticide.
- to understand the correlation of stereochemistry of pesticide and pesticidal activity.
- to inculcate the awareness about the hazards of pesticides.

Learning Outcomes:

By studying this course, students will be able to:

- analyze important aspects attributing pesticidal activity to organic molecules.
- explain the strategies involved in synthesis of different pesticides.

- illustrate the impact of stereochemical aspects on pesticidal activity.
- handle pesticides safely in view of human health and environment.

Unit 1: Key Consideration for Pesticidal Activity of Organic Compounds (3 Hours)

a) Chemical structure (key functional groups in pesticides)

b) Mode of action to the selected target

c) Metabolism and metabolites

d) Toxicity concerns mainly human toxicity and ecotoxicity

Unit 2: Insecticides (5 Hours)

Structure, stereochemical aspects and toxicity of the following (synthesis excluded):

a) Alkaloid family: Nicotine

b) Nicotine analogous: Imidacloprid

c) Pyrethrins: Pyrethrin-I and II

d) Pyrethroids: Cypermethrin

Unit 3: Organic Halogenated Compounds as Pesticides (9 Hours)

a) Synthesis of Halogenated Hydrocarbons as Fumigants
   I. Methyl bromide (Bromomethane)
   II. 1,2-Dibromoethane
   III. 1,2-Dichloroethane
   IV. Carbon tetrachloride
b) Synthesis of DDT and Methoxychlor.
c) Synthesis of Hexachlorocyclohexane (BHC) and discussion of its stereoisomers.
d) Synthesis of Chlordane and Heptachlor from Hexachlorocyclopentadiene (HCCP) by Diels Alder reaction and discussion of their stereoisomers.

Ecological problems due to Organic Halogenated Compounds as Pesticides, their toxicity and effect on Human Health

Unit 4: Organophosphorus Insecticides: (6 Hours)

General chemistry of phosphate esters (Esters of Phosphoric and Phosphorothioic acids)

Synthesis of:

- **a)** Vinyl organophosphates: Dichlorvos, Mevinphos (Phosdrin)
- **b)** Phosphorothioates: Parathion, Methyl-parathion
- **c)** Phosphorodithioate: Malathion
- **d)** Heterocyclic phosphorodithioate: Phosmet

Unit 5: Carbamates (4 Hours)

General chemistry of carbamates: N-methyl carbamates and N, N-dimethyl (alkyl) carbamates

Synthesis of Carbaryl, Bendiocarb, MTMC, and Methomyl

Unit 6: Other Agrochemicals (3 Hours)

Synthesis of DNOC, Captan, 2,4-D, Ziram, Zineb, DEET and their uses.

PRACTICAL (60 Hours)

The following synthesis should be carried out starting from 0.5-1.0 g of the organic compound. The product to be recrystallized and melting point to be determined.

(*Experiments 1 to 6 are synthetic analogues of selected chemical class of pesticides*)

1. Synthesis of aryloxy acetic acid class of herbicide (any one of the following)
    a) 4-chlorophenoxy acetic acid
    b) 4-methylphenoxy acetic acid
    c) 2-methylphenoxy acetic acid

2. Preparation of Dithiocarbamate fungicide analogous from aromatic/aliphatic amine and separated as sodium /zinc/ manganese salt.
3. Preparation of urea derivative from phenylisocynate and aniline.
4. Preparation of carbamate derivative from phenylisocynate and alcohol/phenol.
5. Preparation of benzimidazole/2-benzylimidazole /2-Methylbenzimidazole.
6. Synthesis of 3,5-dimethylpyrazole.
7. Preparation of mosquito repellent Diethyl phthalate in two steps:

   Step-1: Preparation of phthalic anhydride

   Step-2 : Preparation of Diethyl phthalate
8. To prepare Neem extract from neem leaves and/or seeds.
9. **Project Writing**: Insecticidal properties of Neem extract and its uses.

Essential /Recommended readings:

1. Buchel, K. H**.** (1983) *Chemistry of Pesticides* **,** John Wiley & Sons, ISBN 13 978-0471056829
2. Melnikov, N.N. (1971) *Chemistry of Pesticides***,** Edited By: Frances A. Gunther, Jane Davies Gunther, Springer, ISBN: 978-1-4684-6253-1
3. Cremlyn, R. (1978) *Pesticides. Preparation and mode of action*, 1st edition John Wiley & Sons, 0471996319
4. Kenneth A, Hessall (2013), *The chemistry of Pesticides, their Metabolism, Mode action and uses in crop,* Bio-Green Books, ISBN13: 978-9386237118
5. Sree Ramulu, U. S. (1979) *Chemistry of insecticides and fungicides*, 3rd Scientific Publishers; Edition: 2020, ISBN: 9789389832020
6. Roberts, T.R., Hutson, D.H., Jewess, P.J. (1998) *Metabolic pathways of agrochemicals: insecticides and fungicides*, Royal Society of Chemistry
7. Matolcsy, G., Nádasy,M., Andriska,V. (1989) *Pesticide Chemistry* 1st Edition, eBook ISBN: 9780080874913

Suggestive readings

1. Handa, S.K. (2008) *Principles of Pesticide Chemistry*, Ed. By Agrobios (India) ISBN-13: 9788177542165
2. Vyas, S. C. (1993*) Handbook of Systemic Fungicide Compounds*. Tata McGraw-Hill.
3. Jim A. Turner (2018) *The Pesticide Manual: A World Compendium*, British Crop Production Council.
4. World Health Organization (2011) *International code of conduct on the distribution and use of pesticides: guidelines for quality control of pesticides* (No. WHO/HTM/NTD/WHOPES/2011.4). World Health Organization.
5. Zweig, G. (Ed.), (2013) *Principles, Methods, and General Applications: Analytical Methods for Pesticides, Plant Growth Regulators, and Food Additives, Vol. 1* (Vol. 1). Elsevier.
6. "IARC Monograph on Evaluation of Carcinogenic Risk of Chemicals to Humans", Supplement 7, International Agency for Research on Cancer, Lyon, 1987.

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