DISCIPLINE SPECIFIC ELECTIVE COURSE – 06

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		
Pesticide Formulation and Application Equipment	**4**	**2**	**0**	**2**	**-**	**NIL**

Course objectives

The Learning Objectives of this course are as follows:

- Identify various types of pesticide formulations (e.g., emulsifiable concentrates, wettable powders, granules, suspension concentrates) and discuss their specific characteristics, advantages, and limitations.
- Analyze the chemical and physical properties that affect the formulation's stability, efficacy, and compatibility.
- Importance of pesticide Labelling
- Analyze how the choice of formulation impacts the selection and performance of application equipment.
- Describe the function and importance of key components in application equipment, such as nozzles, pumps, and pressure mechanisms.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Classify different pesticide formulations with an explanation of their components and respective functions
- Demonstrate Knowledge of Pesticide Formulation and labelling

- Select suitable pesticide application equipment based on specific crop requirements, target pest types, and environmental conditions.
- Ensure Safety and Compliance assurance requirements.

SYLLABUS OF DSE- 06

THEORY COMPONENT-

UNIT 1: (7 Hours)

Introduction and Types of Pesticide formulations:

A Definition, purpose of formulations, Important formulation terms: Active Ingredient, Inert Ingredient, Phytotoxicity, Adjuvant, Carrier, surfactants, emulsifiers, stabilizers, wetting agents, Spray Mix Terminology: solution, suspension, emulsion

B International codes for the formulation type.Wettable powders, soluble powder, solutions, emulsifiable concentrates, aerosols, dusts and granules. Controlled Release Pesticides, Bait. Advantages and disadvantages of individual pesticide formulation

UNIT 2: (12 Hours)

Key aspects for creating a formulation and Conventional formulation:

A Type of surface, Training and equipment, Runoff or drift, Safety to people, animals, and the environment, Habits of the pest, Consideration of mixed pesticides for their capabilities and incompatibilities

B Dusting, Powders/ Dust Formulations (DP), Granules (GR), Water Dispersible Powders/Wettable powders (WDP/WP), Soluble Concentrates (SC), Emulsifiable concentrates (EC), Ultra Low volume (ULV) with respect to their ingredients, advantages and disadvantages.

UNIT 3: (4 Hours)

Introduction to pesticide Application Equipment:

Overview of pesticide application equipment (with few selected examples), each tailored to type of the formulation.

1. Dusters: Manually and Power Operated Dusters
2. Sprayers: Knapsack Sprayers, Hydraulic Sprayers, Aerial Sprayers (Aircraft or drones)

3. Modern trends in pesticide application with Precision Application Equipment: Technological advancement with GPS-guided sprayers and drone-based application systems
4. Types of nozzles: Function of nozzles with different size and hole diameter available as an attachment with these sprayers.

UNIT 4: (7 Hours)

Understanding pesticide Label and Labeling:

Definition, purpose of Label and Labeling, Common Terms Used in Pesticides Labels, Precautionary Statements, Direction for Use Environmental Hazards, Color coding Information on the label Symbols,Toxicity information/ statements, Pictograms, Labels (GHS) warning statements, Information about type of formulation, Name of pesticide, active and inert material, Name of manufacturer, Quantity

PRACTICAL COMPONENT (60Hours)

1. Preparation of Emulsifiable concentrate (EC) formulation of given organic compound as oil in water emulsion(O/W).
2. Preparation of EC formulation: Emulsifiable concentrate of neem oil.
3. Preparation of standard hard water.
4. To determine the emulsion stability of given EC formulation.
5. Determination of bulk density of pesticidalwettable powder (WP).
6. Preparation of WP formulation.
7. Volumetric determination of acidity/ alkalinity of WP.
8. Preparation of Suspension Concentrate (SC) formulation.
9. Determination of wettability of pesticidal WP / Dust/SP.
10. To draw pictograms and indicate:
    a. Advice, Warning and their meaning
    b. Colour Codes and their meaning
11. Write the colour identification band and warning symbol as per toxicity Data (LD_{50}) following Government of India Recommendations (*see***reference -2**)
12. Each student to be assigned project for designing the label manually for any five pesticides. It must cover the detailed aspects of: Pesticide formulation, Manufacturers name, Quantity of Active and inert ingredient, Pictograms/GHS labelling/Toxicity statement(s), Handling instruction, Any other information required for label

13. Student to be demonstrate / visit to the manufacturing unit for pesticide Application Equipment

ESSENTIAL/RECOMMENDED READINGS

1. Agrochemicals-Pesticide formulations | IUPAC https://agrochemicals.iupac.org
2. Report of the committee on manner of labelling of pesticides as per toxicity Dated 09 August,20I9 Ministry of Agriculture & Farmers Welfare Government of India No. 24-01/2019-ClR.Ihttps://ppqs.gov.in/sites/default/files/public_notice_0.pdf
3. Cardarelli, N.F. (2018). Controlled Release Pesticides Formulations.CRC Press.
4. Foy, C.L., & Pritchard, D.W. (1996). Pesticide Formulation and Adjuvant Technology. CRC Press.
5. Hall, F.R., Berger, P.D., & Collins, H.M. (1995). Pesticide Formulations and Application Systems (Vol. 14).
6. Knowles, D.A. (1998). Chemistry and Technology of Agrochemical Formulations. Springer.
7. Parmar, B.S., &Tomar, S.S. (2004). Pesticide Formulation - Theory and Practice. CBS Publishers & Distributors.
8. Wade, R. (1973). Pesticide Formulation. Dekker, Inc.
9. Wade, V.V., Sugavanam, B., &Khetan, S.K. (1998). Pesticide Formulation. New Age International Publishers.
10. Ware, G.W. (1994). The Pesticide Book (4th ed.). W.H. Freeman: Fresno, CA.

KEYWORDS: Pesticide formulations, Conventional formulation, pesticide application equipment,Pesticide Label and Labeling, Suspension Concentrate formulation

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