CH-331 Agricultural Chemistry

Credit Hours: 2-1

Pre-requisite: Nil

Course Objectives

1. This course aims to provide students with a comprehensive understanding of soil chemistry, nutrient dynamics, and agrochemical applications in agriculture. It covers soil formation, classification, and physicochemical interactions involving minerals, organic matter, and microbial ecosystems. Students will explore the roles, transformations, and mobility of macro- and micronutrients, as well as the chemistry and management of fertilizers, pesticides, and plant hormones. Emphasis is placed on environmental impacts, food safety standards, and sustainable practices such as integrated nutrient management (INM), precision agriculture, and climate-smart technologies for cleaner and more efficient agricultural production.

Course Contents

2. Soil formation, classification, and physicochemical properties, interactions of soil minerals, organic matter, and humic substances, soil colloids and ion exchange mechanisms (CEC, AEC), soil pH, salinity, alkalinity, and redox chemistry, soil microbial ecosystems and their chemical roles, sacro- and micronutrients: biochemical roles, deficiency symptoms, and toxicity, nutrient bioavailability, mobility, and soil-plant interactions, chemical transformations of N, P, K, S, Ca, Mg, Fe, Zn, Cu, Mn, B, and Mo, soil amendments, liming, and gypsum applications, types and formulations: synthetic (Urea, DAP, SSP, MOP) and organic fertilizers, industrial production processes and quality control, organic amendments: compost, vermicompost, green manure, and biochar, biofertilizers, pesticide chemistry and management, chemical classes: organophosphates, carbamates, pyrethroids, neonicotinoids, mechanisms of action, degradation pathways, and environmental fate, toxicology, human health risks, and antidote strategies, integrated pest management (IPM) and biopesticides, hormones: auxins, gibberellins, cytokinins, ethylene, abscisic acid, applications in stress mitigation, flowering, and yield optimization, biochemical and molecular

mechanisms of action, maximum residue limits (MRLs): Codex Alimentarius, FAO/WHO, EPA standards, food safety regulations: Pakistan's framework and global compliance, environmental impacts of agrochemical overuse (eutrophication, soil degradation), strategies for pollution mitigation and cleaner production, integrated nutrient management (INM) and organic farming, precision agriculture: sensor-based nutrient and pesticide application, climate-smart practices and agrochemical innovations.

Course Outcomes

By the end of this course, the students will be able to:

3. Explain core principles of agricultural chemistry, including plant nutrition, agrochemicals, and soil-plant interactions.
4. Analyze the effects of fertilizers, pesticides, and bio-stimulants on crop yield, soil health, and environmental sustainability.
5. Develop strategies for sustainable agricultural practices by integrating chemical knowledge with modern farming techniques.

Relevant Experiments

1. Soil analysis: pH, electrical conductivity (EC), texture, and organic matter; Measurement of nitrate, phosphate, and potassium content of soil; Pesticide residue detection using qualitative and quantitative methods; Preparation and analysis of compost and vermicompost; Bioassays for plant growth regulators (seed germination, root elongation).

Recommended Books

1. Lamb, E. (2022). *Agricultural Chemistry: Concepts and Applications* (1st ed.). NY Research Press. ISBN: 9781632388377
2. Gill, T. (2022). *Introduction to Agricultural Chemistry*. Willford Press. ISBN: 9781682859995
3. Dhok, R. (2021). *Agricultural Chemistry*. Savitribai Phule Pune University. ISBN: 9789354571787
4. Reddy, P.P. (2019). *Agro-ecological Approaches to Pest Management for Sustainable Agriculture*. Springer Singapore. ISBN: 9789811043246
5. Hudson, B. (2017). *Agricultural Chemistry.* Larsen and Keller Education. ISBN: 9781635490169
6. Brady, N.C., & Weil, R.R. (2016). *The Nature and Properties of Soils* (15th

ed.). Pearson. ISBN: 9780133254488

7. Anderson, T. (2015). *Elements of Agricultural Chemistry*. CreateSpace Independent Publishing Platform. ISBN: 9781514761663
8. Havlin, J., Tisdale, S., Nelson, W., & Beaton, J. (2014). *Soil Fertility and Fertilizers: An Introduction to Nutrient Management*. 8th Edition. Pearson. ISBN: 9780135033739
9. Current Literature and Reviews.