Udai Pratap (Autonomous) College, Varanasi

Department of Agricultural Chemistry and Soil Science

Revised Syllabus (2025)

Course- B.Sc (Hons.) Agriculture

Subject- Agricultural Chemistry and Soil Science

(As per 6th Dean Recommendation)

S. No.	Semester	Course Code	Course Title	Credits
1	I	SAC-111	Fundamentals of Soil Science	03 (2+1)
2	I	SAC-112	Environmental Studies and Disaster Management	03 (2+1)
3	II	SAC-121	Soil Fertility Management	03 (2+1)
4	IV	SAC-221	Problematic Soils and their Management	02 (1+1)
5	VI	SAC-321	Essentials of Plant Biochemistry	03 (2+1)
6	VII	SAC-411	Agrochemicals (Elective Course)	04 (3+1)
		Total		**18 (12+06)**

1. Fundamentals of Soil Science (SAC-111) 03 (2+1)

Theory

Soil: Pedological and edaphalogical concepts. Rocks and minerals, weathering, Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity), Soil formation, Soil organic matter, Pedogenic processes, Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils, Soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water. Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India.

Practical

Study of general properties of minerals, study of minerals-silicate and non-silicate minerals, study of rocks-igneous, sedimentary and metamorphic rocks; study of a soil profile, collection and processing of soil for analysis, study of soil texture-feel method, mechanical analysis, determination particle density and soil porosity, determination of soil colour, study of soil structure and aggregate analysis, determination of soil moisture, determination of soil moisture constants field capacity; water holding capacity. Study of infiltration rate of soil, determination of pH and Electrical conductivity of soil.

2. Environmental Studies and Disaster Management (SAC-112) 03 (2+1)

Theory

Introduction to Environment - Environmental studies: Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity.

Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster management: Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

Practical

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Energy: Biogas production from organic wastes. Visit to wind mill / hydro power / solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and un polluted system. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of *E. coli* in water sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystem – Visit to pond/river/hills. Visit to areas affected by natural disaster.

3. Soil Fertility Management (SAC-121) 03 (2+1)

Theory

History of soil fertility and plant nutrition. criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Chemistry of macro and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests. Indicator plants. Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches.

Integrated nutrient management. Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customised fertilisers, water soluble fertilizers nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order. Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading, Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes).

Practical

Introduction of analytical instruments and their principles, calibration and applications of Coloremetry and flame photometry; Estimation of alkaline hydrolysable N in soils;

Estimation of soil extractable P in soils; Estimation of exchangeable K in soils; Estimation of exchangeable Ca and Mg in soils; Estimation of soil extractable S in soils; Estimation of DTPA extractable Zn in soils; Estimation of N in plants; Estimation of P in plants; Estimation of K in plants; Estimation of S in plants.

4. Problematic Soils and their Management (SAC-221) 02 (1+1)

Theory

Soil quality and health, Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties. Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils. Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil

mined), Management of Riverine soils, Waterlogged soils, Irrigation water – quality and standards, utilization of saline water in agriculture. Use of Remote sensing and GIS in diagnosis and management of problem soils. Irrigation and water quality. Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.

Practical

Determination of pHs and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO_3, HCO_3, Cl, SAR and RSC), Determination of nitrate (NO_3^-) from irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples.

5. Essentials of Plant Biochemistry (SAC-321) 03 (2+1)

Theory

Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components. Bio-molecules – Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids. Vitamins – physiological and metabolic role. Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes. Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. Biosynthetic Pathways – Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.

Practical

Preparation of standard solutions and reagents, Determination of pH, Qualitative tests of carbohydrates and amino acids, Quantitative estimation of soluble sugars and starch, Estimation of protein by Kjeldhal method and Lowry's method, Preparation of mineral solution from ash, Estimation of fat by Soxhlet method, Determination of acid value,

saponification value and iodine number, Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites.

6. Agrochemicals (Elective Course) (SAC-411) 04 (3+1)

Theory

An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture. Herbicides -Major classes, properties and important herbicides. Fate of herbicides. Fungicides- classification –Inorganic fungicides- characteristics, preparation and use of sulphur and copper. Mode of action- Bordeaux mixture and copper oxychloride. Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification and insecticides: inorganic and organic insecticides organochorine, Ogranophosphates, Carbamates, Synthetic pyrethriods Neonicotinoids, Biorationals. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use. Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses. Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibilitypreparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitrophosphates and NPK complexes. Fertilizer control order. Fertilizer logistic and marketing. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used.

To study and identify various formulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide.

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Subject: Vocational Course	
Course Code:	Course Title: **Basics of Organic Farming**
Credits:**1**	Course: Elective
Max. MARKS: **40+60**	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:**1-0-0**	

Unit	Topics	No. of Lectures
	Basics of Organic Farming	
I	Organic Farming- Introduction and Principle, Organic Farming Vs. Conventional Farming, Role of National and International organizations for the development of organic farming, Approaches; Benefits and Scope of Organic farming, National and International Organic Markets, Organic farm design, Characteristics and components of organic farm, Planning and layout of organic farm, Land preparation, Types of tillage, Composting and Manuring, Bio-fertilizers, Livestock management in organic farm , Farm structure- cattle shed; store house; farm office	5
II	Field crops and Trees in organic farm, Boarder trees, Agroforestry, Packages and Practices of different crops under organic cultivation, Water Management in organic farm, Soil, Water and Air contamination in organic farm and its control, Crop Rotation, Plant Protection in organic farm- Cultural and mechanical practices; Botanical pesticides; Microbial bio-pesticides, Bio Control Agents-Predators; Parasitoids; Pathogen, Biological control procedures, Economics of organic production Markets and marketing of organic products	5
III	National and International organic norms, Group certification- Internal control system (ICS), Participatory organic certification, Inspection, and certification of organic produce- Documentation; Development of Internal control system (ICS); Quality Management of certification bodies; Third party certification, National Standards for organic production (NSOP), Chain of Custody, Certification trademark, The IFOAM and its organic certification norms	5

Suggested Readings

1. Principles of Organic Farming- by S. R. Reddy, *Kalyani Publishers*, New Delhi.
2. Organic Farming (Theory and Practice) - by S. P. Palaniappan and Annadurai, *Scientific Publishers*, New Delhi

This Course can be opted as an Elective by the students of following subjects

Open to all

Continuous Internal Evaluation (CIE) Methods

20 Marks for Test/ Quiz/ Assignment/ Seminar
05 Marks for Class Interaction

21/7/25 21/7/25 21/7/25

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Subject: Vocational Course	
Course Code:	Course Title: **Basics of Organic Farming (Practical)**
Credits:**2**	Course: Elective
Max. MARKS: **40+60**	Min. Passing Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:**0-0-4**	

Topics	**No. of Lectures**
Basics of Organic Farming	
1. Soil sampling 2. Determination of Soil pH. 3. Determination of Soil Organic Carbon and Organic Matter content. 4. Utilization of various natural products and Bio-fertilizers during preparation of Nursery for organic farming. 5. Identification of various organic products for supplying nutrients to soil. 6. Estimation of various organic products for supplying nutrients under various field crops. 7. Preparation of Farm Yard Manure (FYM) and Compost. 8. Preparation of various plant protection inputs. 9. Utilization of Sprayer and Duster for spraying in Pest control and Nutrient management. 10. Determination of moisture content in seeds of various crops. 11. Field visit for identifying difference between healthy and diseased crops. 12. Field visit of an organic farm.	60
Suggested Readings 1. Principles of Organic Farming- by S. R. Reddy, *Kalyani Publishers*, New Delhi. 2. Organic Farming (Theory and Practice) - by S. P. Palaniappan and Annadurai, *Scientific Publishers*, New Delhi	
This Course can be opted as an Elective by the students of following subjects	
Open to all	
Continuous Internal Evaluation (CIE) Methods	
10 Marks for Record File (depending upon the no. of experiments performed out of the total assigned experiments) 10 Marks for Viva Voce 05 Marks for class interaction	

21/7/25

21/7/25

Udai Pratap (Autonomous) College, Varanasi

Department of Agricultural Chemistry and Soil Science

Revised Syllabus (2025)

Pre Ph. D Coursework

Subject- Agricultural Chemistry and Soil Science

Department of Agricultural Chemistry and Soil Science
Udai Pratap (Autonomous) College, Varanasi
Syllabus of Ph.D Coursework

Course-SAC-601 (Advanced Agricultural Chemistry and Soil Science)

Credit- 04

Unit-1

Composition of earth crust and its relationship with soils; Rocks, minerals and other soil forming materials; Weathering of rocks and minerals; Factors of soil formation; Pedogenic processes and their relationships with soil properties; Soil development; Pedon, polypedon, soil profile, horizons and their nomenclature. Soil Taxonomy - epipedons, diagnostic subsurface horizons and other diagnostic characteristics, soil moisture and temperature regimes, categories and criteria for soil classification systems. Soil mineralogy and clay minerals classification, structure, compostion, properties, genesis, transformation and identification techniques.

Unit-2

Soil texture - textural classes. Soil structure - classification, soil aggregation and significance, soil consistency, soil crusting, bulk density and particle density of soils and porosity, their significance and manipulation. Soil water- retention and potentials. Soil moisture constants. Movement of soil water - infiltration, percolation, permeability, drainage and methods of determination of soil moisture. Darcy's law. Thermal properties of soils, soil temperature, Soil air- composition, gaseous exchange, influence of soil temperature and air on plant growth.

Unit-3

Chemical composition of soil; Soil colloids - structure, composition, constitution of clay minerals, amorphous clays and other non-crystalline silicate minerals, oxide and hydroxide minerals; coordination theory, Charge development on clays and organic matter; pH- charge relations; Buffer capacity of soils. Soil organic matter fractions, clay organic interaction. Inorganic and organic colloids-surface charge characteristics, diffuse double layer theories, zeta potential stability, coagulation/ flocculation, peptization, electrometric and sorption properties of soil colloid. Cation exchange-theories, adsorption isotherms, anion exchange, Nitrogen, potassium, phosphate and ammonium fixation in soils and management aspects. Quantity/intensity relationship and nutrient availability. Chemistry of acid, salt-affected soil, Chemistry and electrochemistry of submerged soils and management aspects.

Unit-4

Essential elements in plant nutrition; Nutrient cycles in soil; Transformation and transport of nutrients (Macro and micro nutrients) in soil; Manures and fertilizers; Fate and reactions of fertilizers in soils; Chemistry of production of different fertilizers; Slow release fertilizers and nitrification retarders; Quality control of fertilizers. Soil fertility evaluation - soil testing, plant and tissue tests and biological methods; Common soil test methods for fertilizer recommendation; Soil test-crop response correlations; Integrated nutrient management; Fertility status of major soil groups of India. Concept and application of soil health and soil quality, Heavy metal toxicity and soil pollution; Chemical and bio-remediation of contaminated soils.

Unit-5

Soil biota, soil microbial ecology, Soil microbial biomass, microbial interactions. Microbiology and biochemistry of root-soil interface, Phyllosphere, Microbial transformations of N, P, K, S, Fe and Zn in soil. Biochemical composition and biodegradation of soil organic matter and crop residues. Humus formation. Biofertilizers - definition, classification, specifications, method of production and role in crop production.