

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF ALLAHABAD
ALLAHABAD

M.Sc. (Ag. Chemistry & Soil Science)
Syllabus & Instruction Manual

M.Sc. Degree in Agricultural Chemistry and Soil Science

The course shall be of two years duration (M.Sc. Previous and Final) and shall be open to graduates in science with agriculture. The examination shall be by

1. Theory papers
2. Practical examination and Viva-Voce

Candidates will be required to pass in the written and practical examinations separately in previous and final examination.

The written examination will comprise of the following papers.

M.Sc. Ag. Chemistry and Soil Science (Previous)

Paper I	Fundamental of Chemistry	100 marks
Paper II	Physico-chemical Principles and soils Physics	100 marks
Paper III	Phyto-organic Chemistry	100 marks
Paper IV	Soil Chemistry and Soil Technology	100 marks
		TOTAL 400 marks

The allotment of marks for practical examination in previous will be as follows:

Practical experiments	150 marks
Record and Viva-Voce	50 marks
TOTAL 200 marks	

M.Sc. Ag. Chemistry and Soil Science (Final)

Paper I	Soil Microbiology and Organic matter Decomposition	75 marks
Paper II	Agro-chemicals and Pesticides chemistry	75 marks
Paper III	Environmental Chemistry of soils	75 marks
Paper IV	Clay Mineralogy and Pedology	75 marks
		TOTAL 300 marks

The allotment of marks for final examination in practical examination, thesis and Viva-Voce will be as follows:

Practical experiments	100 marks
Thesis and Viva-Voce	100 marks
TOTAL 200 marks	

GRAND TOTAL M.Sc. Ag. (Previous + Final) 600 + 500 = 1100

SYLLABUS

The figures in parentheses in the syllabi of the theory paper denote the number of lectures which should be allocated the coverage of the respective topics.

M.Sc. (Previous Agri. Chemistry & Soil Science)

PAPER I : FUNDAMENTALS OF CHEMISTRY

General Chemistry (2), Structure and Bonding (4), electronic configuration of atom (2), Valency (4), Oxidation and reduction (4); Periodic classification of elements, General Characteristics of s, p, d, f, block elements (4); Ionisation, energy (2), Ionic radii (2); Electron affinity (2), Electronegativity (2), Chemistry of important compounds of the elements essential for plants (N, P, K, Ca, Mg, S, Fe, Mn, Mo, Cu, Zn, B, Cl, Ni, Co, Se) (6).

The Chemistry of silicates (2), clay minerals (2); Complex compounds (2); Uses of complex salts in agriculture (2).

Application of chemical principles and knowledge in the field of Nanoscience and Technology (4). A general information about electrolytic dissociation (2); solubility product (2); common ion effect (2), Activity coefficient, pH and buffers (3). Principle of volumetric analysis (2), Acid – Base titration (2), Redox potential and precipitation (2), Complexometric titrations (2); Adsorption indicators (2); Principles of gravimetric analysis (2), Chromatography (2); Principles involved in colorimetry (2), Flame photometry and X- ray diffraction techniques (3); Conductometric and potentiometric methods of analysis (3). Infrared spectroscopy .

PAPER II : PHYSICO-CHEMICAL PRINCIPLES AND SOIL PHYSICS

Ion Exchange and surface phenomena (4), Adsorption as a surface phenomena (2), various equations of adsorption (2). Electro kinetic phenomena (2), Electrophoresis (2), Zeta potential (2), osmosis (2); Theory of Dilute solution (2); colloidal state (2), soil as a colloid (2); properties of colloids (2), Law of Mass action (2); Photochemistry (2).

Physical properties of soil and their influence on plant growth (4); Mechanical composition of soils (2); Stokes law (2); Methods of mechanical analysis (2); Relationship between mechanical analysis and physical properties of soil (2); soil texture (2); soil structure (2), Tillage and tillage (2), Soil aeration (4), Soil temperature (4); Soil color (4) Soil water, forms of soil water, methods of measuring moisture, soil water

plant relationship, Soil moisture retention characteristics (6), Soil survey, types of soil survey Land-use classification (4); Soil Monoliths (2), Essential plant nutrients (2), Major, Secondary and Micronutrients (2), Manures and Fertilizers (2), Chemistry of production of different Fertilizers (4), Complex fertilizers and Fertilizers Mixtures (4); Slow release fertilizers and nitrification (2), Soil conditioners and amendments (4).

PAPER III: PHYTO – BIOCHEMISTRY

Chemistry, classification and synthesis of Carbohydrates (4), Fats and Proteins (structures not required) (4). Metabolism of Carbohydrates (4), Fat and Protein (4); Amino acids and their importance (4). R.N.A. and D.N.A.(4); Biotechnology and Genetic Engineering (4); Tissue culture (2); Transpiration (2), Guttation (2), Enzymes and enzymatic activity (4); Vitamins and their biological importance (4), Plant acids, their biosynthesis and distribution (4); Photoperiodism (2), Plant pigments (2); Fermentation (2); Dormancy and germination of seed (4), Chemical changes during germinations, growth and ripening (4); Phosphorylation (2); ATP and ADP (2); Phytohormones (2), Plant growth regulators (2); Hydroponics (2); Mineral Nutrition in plants (2), Role of Plant physiology in agriculture (4). Absorption of nutrients by plants (2). Antibiotics and their uses in agriculture (4).

PAPER IV : SOIL CHEMISTRY AND SOIL TECHNOLOGY

Chemical composition of soil (4), Rocks and Minerals (2); Weathering of rocks (4); Soil Formation (4), processes of soil formation (4); Formation and Development of soil profile (2); Clay minerals (2); classification and identification of clays (2); cation and anion exchange (2); Fixation of Nutrients (4), Soil Organic matter, Humus, Clay- humus complex (4), Soil reactions and Buffering (4). Soil erosion (2), Factors affecting soil erosion (2); Methods of controlling soil erosion (2), Soil Conservation (4).

Soil Taxonomy (4), Detailed study of various classification (4), 7th approximation classification (4), Major Soil groups of India, their characteristics and distribution (4); Problems related to soil – Acid soils, saline and alkali soils, their formation and reclamation (4). Irrigation water Quality (4), Management of water- logged soils (2), Remote sensing and its uses in soil and water conservation (4).

Soil fertility and productivity (4); Integrated Nutrient Management (4), Nutrient use efficiency (2), Organic farming (2), Sustaining Soil Fertility (2), Soil Fertility Evaluation (2).

PRACTICAL SYLLABUS

M.SC. (PREVIOUS AGRI. CHEMISTRY AND SOIL SCIENCE)

1. Qualitative detection of ions (cations and anions):

Pb^{2+} , Cu^{2+} , Cd^{2+} , As^{3+} , Fe^{3+} , Cr^{3+} , Zn^{2+} , Mn^{2+} , Ni^{2+} , Co^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , and NH_4^+

F^- , Cl^- , Br^- , I^- , S^{2-} , SO_4^{2-} , NO_3^- , CO_3^{2-} , $C_2O_4^{2-}$, CH_3COO^- , PO_4^{3-} ,

2. Determination of following ions, including binary mixture, in aqueous medium. Volumetric and Gravimetric technique in aqueous media.

Fe^{3+} , Ca^{2+} , Mg^{2+} , Zn^{2+} , $C_2O_4^{2-}$, SO_4^{2-} , Cl^- , and PO_4^{3-}

3. Determination of CO_3^{2-} and HCO_3^- in irrigation water

4. Chromatography and its application in the separation of amino acids and Humic acids.

5. Physico-Chemical Measurement in Soil :

- Determination of particle size, pore space, bulk density of soils.
- Determination of moisture contents of soils
- Measurements of Conductivity of soils.
- pH Measurements.

SYLLABUS
M.Sc. (Final) Agri. Chemistry & Soil Science

**PAPER I: SOIL MICROBIOLOGY AND ORGANIC MATTER
DECOMPOSITION**

Microbial diversity (2), Soil Population (2), occurrence and distribution of micro-organism in soils (4), Classification of micro-organism (4), Soil as a medium for growth and activities of micro-organisms (2), Soil Bacteria (4), Soil Algae (4), Soil Fungi (4), Actinomycetes (4), Protozoa (4); Protozoan theory of Soil Fertility (2), Influence of environment and soil conditions on the activity of micro-organisms (2). Effect of Soil treatment such as fertilizer and manure application, tillage operation (2), Partial sterilization of soil micro-organism (2); Soil inoculation (2); Bio-fertilizers, Classification and uses (4); Role of micro-organism in nutrients availability (2), Mycorrhiza and plant nutrition (2), Decomposition of plant residues (4); Cellulose and complex carbohydrate decomposing microorganisms (4), Role of micro-organisms in organic matter decomposition and nutrient transformation (6); Nutrient cycles in Soil – Nitrogen Cycle (2), Carbon Cycle (2), Phosphorus cycle, Sulphur cycle (2); Reclamation of alkali soils by sulphur oxidizing micro-organism (2); Role of blue green algae in rice fields (2), Biological Nitrogen Fixation (4).

PAPER II: AGROCHEMICALS AND PESTICIDES CHEMISTRY

General aspect of pest and pesticide management (4), Basic concepts and uses of Insecticides (4), Fungicides (4), Herbicides (4), Rodenticides (4), Nematocides (4), Fumigants (4). Mode of action of different pesticides (6), Insecticides of Botanical origin (3); Formulation of Pesticides – Solid and Liquid formulations (6), Adjuvant (2), Desirable characteristics of an ideal Pesticide (2), Pesticide residue; Concept and toxicological significance (4), Pesticide residue analysis (4), Persistence of Pesticides, Interaction of Soils and Pesticides (6), Bio-remediation of pesticide contaminated soils (6). Fate of pesticide in the Environment, Abiotic and Biotic transformations (6); Microbial and photochemical degradations (2), Integrated Pest Management-Cultural, Mechanical and Biological Control of Pests (6); Safety aspects, Pesticides poisoning and antidotes (4).

PAPER III: ENVIRONMENTAL CHEMISTRY OF SOILS

Environmental Pollution (2), causes of Environment Pollution (2), Environmental Monitoring (2), Soil Quality and Soil Health (4), Parameters of Soil Quality (2), Management of Soil Quality (4), Soil Pollution (2), Sources of Soil Pollution (2), Major contaminants of Soil (2), Heavy metal toxicity and Soil Pollution (2); Soil Pollution through industrial effluents, Sewage, Pesticides and Fertilizers (4), Soil factors in emission of green house gases (2), Radio – active contamination of soil (4); Fate of pollutants in the

control and management of Soil Pollution (4), Phyto-remediation of contaminated Soil (4), Soil health management (4), Soil testing (2), Fertilizer recommendation on the basis of soil testing (4), lime requirement (2), Gypsum requirement (2), Cation exchange in soils (2), Cation exchange capacity of soil (2), Anion exchange (2), Fixation of nutrients (4).

PAPER IV: CLAY MINERALOGY AND PEDOLOGY

Fundamentals of silicate clay structure (4), Origin and occurrence of clay minerals (4), Constitution of clay minerals (4), Classification of clays- Kaolinite, Montmorillonite, Illite etc (6). Charge development on clays (2); Chemical composition of silicate clays (4), Genesis of silicate clays (2), Transformation of clay minerals under various conditions (4), Separation and identification of clay minerals (4), Different methods of identification of clays (4). The significance of clay in soils (4). Soil Genesis (2), Pedology (2), Soil as a natural body (2), Micropedology (4), Microchemical methods used for investigation of soil constituents (4).

Geochemistry of soils (4), scope of Geochemistry (2), Relationship between Geochemistry and Soil Fertility (2), Distribution of elements during evolution of earth (4), Clay humus complex (2).

PRACTICAL SYLLABUS
M.Sc. (FINAL) AGRI.CHEMISTRY AND SOIL SCIENCE

1. Available plant nutrients in soil-available N, P and K. Micronutrients in soils-Cu, Zn, Mn, Fe.
2. Exchange reaction, Exchangeable cations in soils, Cation Exchange capacity of soils.
3. Soil acidity and alkalinity, Exchangeable H, Al, Exchangeable Na, Gypsum requirement, Lime requirement.
4. Quality of irrigation water.
5. Soil organic matter-total carbon in soils, Isolation of humic substances, Determination of C/N, C/P and C/S ratios in soils.
6. Analysis and formulation of important insecticide and fungicides viz. D.D.T., B.H.C., Organophosphates, arsenicals.
7. Persistence of insecticides in soil.

THESIS