

## DEPARTMENT OF NATURAL RESOURCE MANAGEMENT

Course No. : H/SSAC-111

Course Title: Fundamentals of Soil Science

Credit: (1+1) 2

Semester: I

### Theory –

Composition of earth's crust, Soil as a natural body- major components. Formation of Soil – soil forming factors and Pedogenic processes. Physical properties- Texture definition, methods of textural analysis, Stock's law, assumptions, limitations, textural classes, use of textural triangle. Absolute Specific gravity/particle density definition, apparent specific gravity/bulk density porosity, factors influencing BD. Relation between BD & Porosity Pore space: definition, factors affecting capillary & non- capillary porosity. Soil colour-definition, significance, Munsell soil colour chart. Factors influencing soil colour- parent material, soil moisture and organic matter. Soil structure: definition, classification, clay prism like structure, and Genesis. Factors influencing soil structure. Soil consistence, plasticity, Atterberg's limits. Soil air : composition, factors influencing , soil air, gaseous exchange/ renewal and effect on plant growth. Soil Temperature : Sources ,distribution of heat, factors influencing soil temperature and measurement of soil temperature and effect on plant growth. Soil chemical properties: Soil colloids: organic, humus, inorganic, secondary silicate clays and hydrous oxides. Ion exchange: cation and anion, importance of ion exchange. pH and nutrient availability, soil buffering capacity. Soil organic matter: sources, factors, decomposition and importance. Soil water, energy concepts, measurement of soil water, movement, pF scale. Soil biology :importance soil microbes, benefits and harmful effects. Soil taxonomy (soil orders), land capability classification, Soils of different ecosystems and their properties. Methods and objective of soil survey. Soil erosion, types and control measures. Aerial photography : Satellite image interpretation, Soil survey , types and importance ,Remote sensing application in soil and plant studies. Soil degradation, soil compaction, compression, Problematic Soils –Salt affected soil, Acid soil, Flooded and Coastal saline soil properties. Management of problematic soils. Soil environmental quality.

### Teaching Schedule

Lecture No.	Topic	Weightage
1	Composition of earth's crust, Soil as a natural body- major components	5
2	Formation of Soil – soil forming factors and Pedogenic processes.	5
3	Physical properties- Texture definition, methods of textural analysis, Stock's law, assumptions, limitations, textural classes, use of textural triangle.	10
4	Absolute Specific gravity/particle density definition, apparent specific gravity/bulk density porosity, factors influencing BD. Relation between BD & Porosity Pore space: definition, factors affecting capillary & non- capillary porosity	7.5
5	Soil colour-definition, significance, Munsell soil colour chart. Factors influencing soil colour- parent material, soil moisture and organic matter.	5
6	Soil structure: definition, classification, clay prism like structure, and Genesis. Factors influencing soil structure. Soil consistence, plasticity, Atterberg's limits.	5
7	Soil air : composition, factors influencing , soil air, gaseous exchange/ renewal and effect on plant growth	5
8	Soil Temperature : Sources ,distribution of heat, factors influencing soil temperature and measurement of soil temperature and effect on plant growth	7.5
9	Soil chemical properties: Soil colloids: organic, humus, inorganic, secondary silicate clays and hydrous oxides	5
10	Ion exchange: cation and anion, importance of ion exchange.	5
11	pH and nutrient availability, soil buffering capacity.	5

12	Soil organic matter: sources, factors, decomposition and importance.	5
13	Soil water, energy concepts, measurement of soil water, movement, pF scale.	5
14	Soil biology :importance soil microbes, benefits and harmful effects	5
15	Soil taxonomy (soil orders), land capability classification, Soils of different ecosystems and their properties. Methods and objective of soil survey Soil erosion, types and control measures.	10
16	Aerial photography : Satellite image interpretation, Soil survey , types and importance ,Remote sensing application in soil and plant studies Soil degradation, soil compaction, compression, Problematic Soils –Salt affected soil, Acid soil, Flooded and Coastal saline soil properties. Management of problematic soils. Soil environmental quality.	10
	<b>Total</b>	<b>100</b>

### Practicals-

Basic analytical concepts, techniques and calculation. Collection and preparation of soil samples for horticultural crops. Determination of moisture content in soil by gravimetric method. Determination of pH and EC of soil sample. Determination of calcium carbonate by Rapid Titration method. Determination of Organic carbon by Walkely and Black method. Determination of Bulk density and porosity of soil. Textural analysis of soil by Boucouyos hydrometer method. Determination of available nitrogen content in soil. Determination of available Phosphorus from soil. Determination of available Potassium from soil. Determination of available sulphur from soil. Determination of DTPA extractable micronutrient from soil. Description of soil profile in field. Determination of soil colour using Munsell colour chart, Estimation of water holding capacity , Field capacity, Permanent wilting point and Determination of soil water potential characteristic curve by tensiometer and pressure plate apparatus Visit to Soil and Water Clinic.

### Practicals

Ex. No.	Title
1	Basic analytical concepts, techniques and calculation.
2	Collection and preparation of soil samples for horticultural crops
3	Determination of moisture content in soil by gravimetric method
4	Determination of pH and EC of soil sample
5	Determination of calcium carbonate by Rapid Titration method
6	Determination of Organic carbon by Walkely and Black method
7	Determination of Bulk density and porosity of soil
8	Textural analysis of soil by Boucouyos hydrometer method
9	Determination of available nitrogen content in soil
10	Determination of available Phosphorus from soil
11	Determination of available Potassium from soil

12	Determination of available sulphur from soil
13	Determination of DTPA extractable micronutrient from soil
14	Description of soil profile in field
15	Determination of soil colour using Munsell colour chart, Estimation of water holding capacity , Field capacity, Permanent wilting point and
16	Determination of soil water potential characteristic curve by tensiometer and pressure plate apparatus  Visit to Soil and Water Clinic

### **Suggested Reading**

1. Brady, N. C. 2016. The Nature and Properties of Soils. 15th edition Publisher: Pearson Education, ISBN: 978-0133254488.
2. Biswas, T.D.; Mukherjee, S.K.. 1995. Text Book of Soil Science 2nd sEd.Tata McGraw Hill Publisher, Delhi pp 433.
3. Das D. K. 2011. Introductory Soil Science, 3rd revised and Enlarged Ed, Kalyani Publisher, Ludhiana. pp. 645.
4. Jakson, M.L. 1973. Soil Chemical Analysis. Printice Hall, India, Pvt. Ltd. New Delhi. pp 498.

**Course No. : H/SSAC – 122**

**Course Title: Soil Fertility and Nutrient Management**

**Credits: (1+1) 2**

**Semester: II**

**Theroy:**

Introduction to Soil fertility and soil productivity :factors Essential nutrient elements and functions, deficiency symptoms. Mechanism of Nutrient transport / uptake to plants and nutrient availability. Acid calcarious and salt affected soil characteristics and management, Role of micro organisms in organic matter decomposition and humus formation, importance of C:N ratio and pH in plant nutrition soil buffering capacity. Integrated plant nutrient management. Soil fertility evaluation methods: chemical, biological and by visual symptoms, critical levels of different nutrients and hidden hunger in soil. DRIS Approach, critical limit approach. Manures and fertilizer classification and manufacturing process. Properties and fate of major and micronutrient in soils. NPK fertilizers: composition and application methodology, luxury consumption, nutrient reactions, deficiency symptom by visual diagnosis. Secondary & Micronutrient fertilizers their types, composition, reaction in soil and effect on crop growth. Fertilizer control order. Plant nutrient toxicity symptoms and remedial measures. Soil test crop response and targeted yield concept. Biofertilizers: importance, types and use in horticultural crop. Nutrients use efficiency (NUE) and management. Effect of potential toxic elements in soil and plant.

**Teaching Schedule**

<b>Sr. No.</b>	<b>Topic</b>	<b>Weight age</b>
1, 2&3	Introduction to Soil fertility and soil productivity :factors Essential nutrient elements and functions, deficiency symptoms. Mechanism of Nutrient transport / uptake to plants and nutrient availability. Acid calcarious and salt affected soil characteristics and management	10
4&5	Role of micro organisms in organic matter decomposition and humus formation, importance of C:N ratio and pH in plant nutrition soil buffering capacity.	10
6	Integrated plant nutrient management	7.5
7&8	Soil fertility evaluation methods: chemical, biological and by visual symptoms, critical levels of different nutrients and hidden hunger in soil. DRIS Approach, critical limit approach,	10
9	Manures and fertilizer classification and manufacturing process. Properties and fate of major and micronutrient in soils	10
10&11	NPK fertilizers: composition and application methodology, luxury consumption, nutrient reactions, deficiency symptom by visual diagnosis	10
12	Secondary & Micronutrient fertilizers their types, composition, reaction in soil and effect on crop growth.  Fertilizer control order	7.5

13	Plant nutrient toxicity symptoms and remedial measures.	7.5
14	Soil test crop response and targeted yield concept	7.5
15	Biofertilizers: importance, types and use in horticultural crop. Nutrients use efficiency (NUE) and management.	10
16	Effect of potential toxic elements in soil and plant	10
	<b>Total</b>	<b>100</b>

## Practicals-

Determination of organic matter from compost / FYM /oil cake (Ignition method), Determination of soil available nitrogen (Subbiah and Asija,, 1956). Determination of available phosphorus in soil (Olsen et al, 1954) for alkaline soils. Determination of soil available potassium in soil. Determination of soil available sulphur in soil. Determination of exchangeable Calcium and Magnesium in soil. Determination of exchangeable Calcium and Magnesium by Versenate (EDTA) Method. Determination of soil Micronutrients. Determination of Lime requirement of Problem soilsDetermination of Lime requirement of acid soils (SMP buffer method) (for soils of pH less than 6) To estimate the Lime requirement of a soil (Hutchinson and MacLenan procedure ) . Fertilizer Adulteration test / Identification of Adulteration in fertilizer / Detection of adulteration in fertilizers (Rapid test). Determination of total nitrogen from FYM / Compost / oilseed cake and C : N ratio (By Kjeldahl method) . Determination of total phosphorus and potassium from compost / FYM. Determination of (Amide nitrogen) from urea. Determination of ammonical nitrogen content of ammonium sulphate. Determination of water soluble phosphorus in superphosphate (Pumberton method) Use of soil testing kit and Use of leaf colour chart for nutrient deficiency diagnosis

## Practicals

Exercise No	Title
1	Determination of organic matter from compost / FYM /oil cake (Ignition method)
2	Determination of soil available nitrogen (Subbiah and Asija,, 1956)
3	Determination of available phosphorus in soil (Olsen et al, 1954) for alkaline soils.
4	Determination of soil available potassium in soil
5	Determination of soil available sulphur in soil.
6	Determination of exchangeable Calcium and Magnesium in soil
7	Determination of exchangeable Calcium and Magnesium by Versenate (EDTA) Method.
8	Determination of soil Micronutrients
9	Determination of Lime requirement of Problem soils Determination of Lime requirement of acid soils (SMP buffer method) (for soils of pH less than 6) To estimate the Lime requirement of a soil (Hutchinson and MacLenan procedure )
10	Fertilizer Adulteration test / Identification of Adulteration in fertilizer / Detection of adulteration in fertilizers (Rapid test)
11	Determination of total nitrogen from FYM / Compost / oilseed cake and C : N ratio (By Kjeldahl method)
12	Determination of total phosphorus and potassium from compost / FYM.
13	Determination of (Amide nitrogen) from urea.
14	Determination of ammonical nitrogen content of ammonium sulphate. Determination of water soluble phosphorus in superphosphate (Pumberton method)

15	Determination of total potassium content of muriate of potash (by flame photometer). And zinc in zinc sulphate.
16	Use of soil testing kit and Use of leaf colour chart for nutrient deficiency diagnosis

### **Suggested Reading**

1. Yawalkar K.S, Agarwal J. P. and Bokkde, 1992. Manures and Fertilizers. Agri. Horticultural Publishing House, Nagpur.
2. Tandan HLS, 1994. Fertilizers Guide. Fertilizers Development Consultation Organizations, New Delhi.
3. Mengel , et al., 2001. Principles of Plant Nutrition (5<sup>th</sup> Edition), Springer
4. Seethramaan, S. Biswas, B.C. Maheshwari, S. and Yadav, D.S. 1986 Hand Book on Fertilizers Technology. The Fertilizers Association of India, New Delhi

**Course No. : H/SSAC-243**

**Course Title: Soil, Water and plant analysis**

**Credit: (1+1) 2**

**Semester: IV**

**Theroy:** Importance and objectives of soil, water and plant analysis Principles of instrumentation in soil, water and plant analysis, Methods of soil, water and plant sampling and processing for analysis, Nutrient mobility, diffusion and mass flow, Renewal of gases in soil and their abundance, Principles and methods of measurement of oxygen diffusion rate and redox potential, Radio tracer technology application in plant nutrient studies and fertility evaluation, Soil micro-organisms and their importance, Saline and alkali appraisal and management, Acid soil appraisal and management, Waterlogged soil appraisal and management, Sandy soil appraisal and management, Chemical and mineral composition of horticultural crops, Leaf analysis standards , index tissue, interpretation of leaf analysis values quality of irrigation water. Rapid tissue test for plant, Management of poor quality irrigation water in crop management Soil pollution and water pollution.

**Teaching Schedule**

<b>Lecture No.</b>	<b>Topic</b>	<b>Weightage</b>
1 & 2	Importance and objectives of soil, water and plant analysis Principles of instrumentation in soil, water and plant analysis	10
3	Methods of soil, water and plant sampling and processing for analysis	7.5
4	Nutrient mobility, diffusion and mass flow	7.5
5	Renewal of gases in soil and their abundance	5
6	Principles and methods of measurement of oxygen diffusion rate and redox potential	7.5
7 & 8	Radio tracer technology application in plant nutrient studies and fertility evaluation	10
9	Soil micro-organisms and their importance	5
10	Saline and alkali appraisal and management	5
11	Acid soil appraisal and management	5
12	Waterlogged soil appraisal and management	5
13	Sandy soil appraisal and management	5
14	Chemical and mineral composition of horticultural crops	7.5
15	Leaf analysis standards , index tissue, interpretation of leaf analysis values quality of irrigation water. Rapid tissue test for plant	10
16	Management of poor quality irrigation water in crop management Soil pollution and water pollution	10
	<b>Total</b>	<b>100</b>

## Practicals:

Collection and preparation of soil, water and plant samples for analysis, Preparation of standard solutions, Determination of pH and EC of soil, Determination of SAR and ESP of soil, Estimation of moisture content in soils and plants, Determination of available nitrogen in soil, Determination of available phosphorus in soil, Determination of available potassium in soil, Determination of DTPA extractable micronutrients in soil, Determination of boron, Determination of pH and EC in irrigation water samples, Determination of Carbonates , bicarbonates sulphates and chlorides in irrigation water, Determination of calcium, magnesium , sodium , potassium and Boron in irrigation water, Determination of NPK calcium , magnesium and sulphur in plant sample, Determination of micronutrients in plant sample , Preparation of plant nutrient deficiency symptoms album.

### Practicals

Exercise No.	Title
1	Collection and preparation of soil, water and plant samples for analysis
2	Preparation of standard solutions
3	Determination of pH and EC of soil
4	Determination of SAR and ESP of soil
5	Estimation of moisture content in soils and plants
6	Determination of available nitrogen in soil
7	Determination of available phosphorus in soil
8	Determination of available potassium in soil
8	Determination of DTPA extractable micronutrients in soil
10	Determination of boron
11	Determination of pH and EC in irrigation water samples
12	Determination of Carbonates , bicarbonates sulphates and chlorides in irrigation water
13	Determination of calcium, magnesium , sodium , potassium and Boron in irrigation water
14	Determination of NPK calcium , magnesium and sulphur in plant sample
15	Determination of micronutrients in plant sample
16	Preparation of plant nutrient deficiency symptoms album

### Suggested Reading Books:

- 1 H.L.S. Tandon. 2013, Methods of analysis of soil, plant, water and fertilizers.



FDCO, New Delhi.

- 2 Yawalkar, K.S. Agarwal, Pand Bokde., 1977 Manuers and fertilizers. Agri-Horticultural Publishing House, Nagpur.
- 3 Sehgal J.A. 2005. Textbook of Pedology Concepts and Applications. Kalyani Publishers, New Delhi.
- 4 Jaiswal, P.C., 2006. Soil, Plant and Water Analysis (2<sup>nd</sup> Edition), Kalyani Publishers, Ludhiana.
- 5 Jackson M.L, 1967. Soil Chemical Analysis, Oxford and IBH Publishing Co., New Delhi.
- 6 P.K. Gupta., 2013, Soil, Plant, water and fertilizer analysis. Agrobios, India.
- 7 M. V. Durai., 2014, Hand book of Soil, plant, water, fertilizers and Manure analysis. New India Publishing Agency.