

Semester : I (New)	Term : I	Academic Year : 2017-18
Course No. : SSAC 111	Title : Fundamentals of Soil Science	
Credits : 3(2+1)		
Day & Date : Monday, 01.01.2018	Time : 09.00 to 12.00	Total Marks : 80

SECTION "A"

Q.1 a) Classify soil structure on the basis of type. Lec 10 & 11
b) Draw a neat diagram of soil profile and label it. - Lect No 9

Q.2 a) Give the composition of plant residue and enlist the sources of soil organic matter.
b) Discuss about soil aeration and its significance.

Q.3 a) Explain the land capability classification.
b) Enlist various soil moisture constants and describe any one.

Q.4 a) Define mineral. Classify minerals on the basis of mode of formation. Lect No 354
b) What is soil formation? Enlist different soil forming processes.

Q.5 a) Define rocks. Give details of metamorphic rocks. Lect No 354
b) Enlist soil orders and explain in detail any one.

Q.6 a) What is ion exchange? State its importance in agriculture.
b) Define soil texture. What is the importance of soil texture in relation to plant growth. Lect 1c

Q.7 a) Explain the physical classification of soil water.
b) Enlist the factors affecting soil temperature. Explain the effect of soil temperature on soil and plant growth.

Q.8 a) Explain the role of soil microorganisms.
b) Enlist the different properties of soil colloid and describe any one.

Q.9 a) Define soil survey. Explain different types of soil survey.
b) What is weathering? Explain in detail chemical weathering.

Q.10 Write short notes (Any Two).

1) Soil pollution	2) Soils of Maharashtra
3) Cation Exchange Capacity	4) Soil pH

Q.11 Define the following terms.

1) Field capacity	2) Pedology	3) Particle density	4) Edaphology
5) Flocculation	6) Elluviation	7) pF	8) Humus

Q.12 Answer in one sentence.

- 1) What is Dyke? - 2009 - 2010
- 2) What is soil consistence? 2009-2010
- 3) Name the cementing agent in soil structure. 2009-2010
Lec No 105/11
- 4) Name the rocks in which the vesicles are filled up with mineral crystals. Lec No. 364
- 5) What is Hue?
- 6) What is streak of mineral? Lec No 384
- 7) Name the scientist who is known as the Father of Soil Science.
- 8) Name two reference books along with authors used for SSAC-111.



MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION

B.Sc. (Agri.) Agriculture
Hons.

MODEL ANSWER PAPER

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- Note: 1. Solve ANY EIGHT questions from SECTION "A".
2. All questions from SECTION "B" are compulsory
3. All questions carry equal marks.
4. Draw neat diagrams wherever necessary.



SECTION "A"

Q.1 a) Classify soil structure on the basis of type.

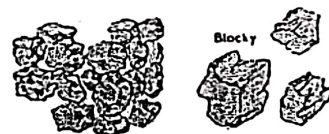
Ans. : There are four principal types of soil structure:

1. Plate-like (Platy), 2. Prism-like, 3. Block Like and 4. Spheroidal

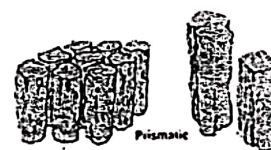
1 Spheroidal: Granular and crumb structures are individual particles of sand, silt and clay grouped together in small, nearly spherical grains. Water circulates very easily through such soils. They are commonly found in the A-horizon of the soil profile;



2 Blocky and subangular blocky structures are soil particles that cling together in nearly square or angular blocks having more or less sharp edges. Relatively large blocks indicate that the soil resists penetration and movement of water. They are commonly found in the B-horizon where clay has accumulated;



3 Prismatic and columnar structures are soil particles which have formed into vertical columns or pillars separated by miniature, but definite, vertical cracks. Water circulates with greater difficulty and drainage is poor. They are commonly found in the B-horizon where clay has accumulated;

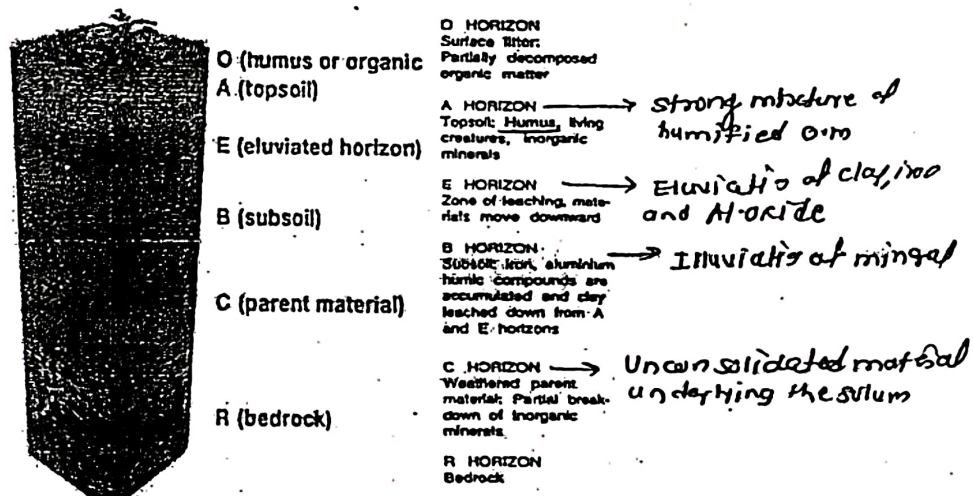


4 Platy structures are made up of soil particles aggregated in thin plates or sheets piled horizontally on one another. Plates often overlap, greatly impairing water circulation. It is commonly found in forest soils, in part of the A-horizon, and in claypan* soils.



b) Draw a neat diagramme of soil profile and label it.

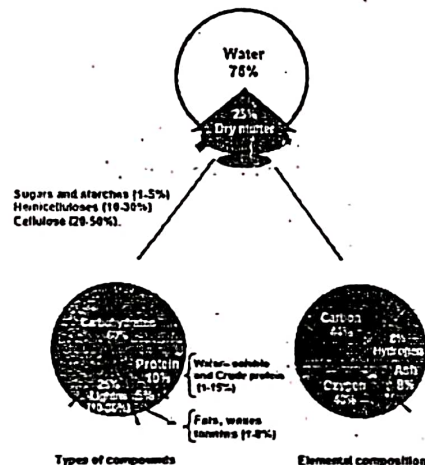
Ans. :



Q.2 a) Give the composition of plant residue and enlist the sources of soil organic matter.

Ans. :

Composition of Plant Residues



Composition of representative green plant materials

Sources of Soil Organic Matter

The primary sources of soil organic matter is plant tissue are :

- The tops and roots of trees
- Shrubs
- Grasses
- Remains of harvested crops
- Soil organisms

Animals usually are considered as secondary source of organic matter.

- Waste products of animals
- Remains of animals after completion of life cycle

b) Discuss about soil aeration and its significance.

Ans. : The constant movement or circulation of air in the soil mass resulting in the renewal of its component gases is known as *soil aeration*.

Composition of Soil Air

Composition of soil and atmospheric air

Air	Percentage by volume		
	Nitrogen	Oxygen	Carbon dioxide
Soil air	79.2	20.6	0.30
Atmospheric air	79.9	20.97	0.03

Significance:

The role of soil air in relation to fertility of soil and plant growth

- Plant and root growth:
- Microorganism population and activity:
- Formation of toxic material
- Water and nutrient absorption
- Development of plant diseases

Q.3 a) Explain the land capability classification.

Ans. : On the basis of the soil survey maps and reports, a land capability classification has been developed in which every acre of land is classified according to its *capabilities* and *limitations*. There are eight capability classes, which are numbered from I to VIII.

Those lands, which have the maximum capabilities and the least limitations, are placed in class I, whereas those lands, which have the maximum limitations and the least capabilities, are placed in class VIII. Class I to Class IV encompasses land suitable for cultivation, unit class V to Class VIII includes land unsuitable for cultivation but suitable for permanent vegetation.

b) Enlist various soil moisture constants and describe any one.

Ans. : Following are the soil moisture constants.

1. Field capacity:
1. Wilting coefficient:
2. Hygroscopic coefficient:
3. Available water capacity:
4. Maximum water holding capacity
7. Sticky point moisture :

Q.4 a) Define mineral. Classify minerals on the basis of mode of formation.

Ans. : A *mineral* is a naturally occurring homogenous element or inorganic compound that has a definite chemical composition and a characteristic geometric form.

Classification of minerals

On the basis of mode of formation minerals are classified into two groups viz. Primary and Secondary mineral.

Primary mineral: A mineral that forms an original component of a rock is known as primary mineral e.g. Feldspar, hornblende, mica. They are originated from original molten magma. They are most prominent in the sand and silt fractions.

Secondary mineral: The minerals which are formed, deposited or introduced as a result of subsequent changes in rocks are known as secondary minerals e.g. Limonite, gibbsite, etc, and clay minerals. Secondary minerals tend to dominate in the clay and in some cases the silt fraction of soil.

b) What is soil formation? Enlist different soil forming processes.

Ans. : • **Soil Formation:** The mode of origin of the soil, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material

Two types of Soil Forming Processes

A. Fundamental Soil forming Processes

1. Humification
2. Eluviation).
3. Illuviation
4. Horizonation

B. Specific Soil Forming Processes

1. Calcification
2. Decalcification:
3. Podzolization
4. Laterization
5. Salinization
6. Desalinization
7. Solonization or Alkalization:
8. Solodization or dealkalization:
9. Pedoturbation

Q.5 a) Define rocks. Give details of metamorphic rocks.

Ans. : A rock may be defined as an aggregate of one or more minerals.

Metamorphic rocks:

Igneous and sedimentary rocks undergo a change. When the change is considerable the rock is said to have undergone metamorphosis and the new rock is known as a metamorphic rock. The metamorphosis is brought about by the action of water heat or pressure.

1. **Dynamo metamorphic rocks:** Dynamo metamorphism is due to pressure

brought about by the folding of rocks due to crust movement of the earth. As a result of this pressure, the crystals in rocks are flattened and they are called as folio e.g. thick in the middle and thin at edges. Such rocks are called foliated rock. When the foliation is slight and the folio are not separate, the rock is called the gneiss. If the crystals are very much flattened and the folio are easily separated, then the rock is called a schist e.g. Gneisses-Granite gneiss, Diorite gneiss.

Schist: Mica, Schist, Quartz, schist, Chlorite, schist, Talc schist.

2) **Thermo metamorphic rock:** Thermo -metamorphism may be caused by volcanic lava and the heat can fuse or melt the original rocks e.g. Sandstone is converted into quartzite and limestone is converted into marble.

3) **Hydro metamorphic rocks:** Water in combination with heat and pressure can bring about chemical changes as well. Hot water or steam converts feldspar into mica and potassium silicate e.g. Basalt and granite converted into slate.

b) Enlist soil orders and explain any one in detail.

Ans. : Soil orders: (2 M)

- | | | | |
|----------------|-------------|---------------|--------------|
| 1. Entisols | 2. Alfisols | 3. Vertisols | 4. Histosols |
| 5. Inceptisols | 6. Ultisols | 7. Aridisols | 8. Andisols |
| 9. Mollisols | 10. Oxisols | 11. Spodosols | 12. Gelisols |

Explanation of any one order. (2 M)

Q6. a) What is ion exchange? State its importance in agriculture.

Ans. : Ion exchange is an exchange of ions between two electrolytes or between an electrolyte solution and a complex.

Importance of Cation Exchange

Source of positive charge

1. Isomorphous substitution:
2. Surface and exposed broken bonds of clay lattice :
3. Complex aluminium and iron hydroxy ions in acid soils.
4. The pH dependent charges are important for anion exchange of organic matter.
5. *Phosphate fixation.*
6. Percent base saturation

b) Define soil texture. What is importance of soil texture in relation to plant growth?

Ans. : *Soil texture* is the relative percentage of sand, silt and clay in a soil.

Importance of Soil texture:

1. Sandy soils are of open character, usually loose and friable. They have little water holding capacity. In such soils, few crops can be grown as potato, groundnut, cucumber, watermelon etc.
2. Clay particles play important role in soil fertility. These soils are difficult

to till and requires more attention for handling. They have high water holding capacity and poor percolation. Susceptible for water logging. These soils are very fertile in respect to plant nutrient content. Variety of crops can be grown very successfully in these soils.

3. Silt is very valuable constituent of soil. These are ideal soils when there is equal proportion of sand, silt and clay. Tillage operations are best in these soils. In loam soils good tilth is obtained easily. They are practically suited to every kind of crops.

Q.7 a) Explain the physical classification of soil water.

Ans. : Physical classification of soil water (Explanation required under each class)

1. Gravitational water
2. Capillary water
3. Hygroscopic water

b) Enlist the factor affecting soil temperature. Explain the effect of soil temperature on soil and plant growth.

Ans. : Factors Affecting Soil Temperature

1. Soil texture
1. Soil structure
2. Soil composition
3. Soil colour
4. Soil moisture
5. Slope of the land Vegetative cover
6. Climate
7. Season

Effects of Soil Temperature on Soil and Plant Growth

The following effects of soil temperature on fertility of soil and plant growth are observed.

1. Soil microorganism
2. Decomposition of Soil organic matter
3. Absorption of soil water
4. Nutrient availability
5. Seed germination
6. Plant growth
7. Soil Formation
8. Physical Properties
9. Plant diseases.

Q.8 a) Explain the role of soil microorganisms.

Ans. : Role of soil microorganisms

1. Organic matter decomposition
2. Inorganic transformation
3. Fixation of nitrogen symbiotic & non symbiotic
4. Formation and development of soil
5. Production of soil enzymes eg. Urease enzyme
6. Soil aggregation

7. Denitrification

8. Development of various plant diseases

9. ~~Production of antibodies and other toxic substances~~ competition for nutrient with the crops (Immobilization)

b) Enlist the different properties of soil colloid and describe any one.

Ans. : Properties of Soil Colloids

1. Size
 2. Surface area
 3. Surface charges
 4. Adsorption of cations
 5. Adsorption of water
 6. Cohesion
 7. Adhesion
 8. Swelling and shrinkage
 9. Dispersion and flocculation
 10. Brownian movement
 11. Non permeability
- (Explain in brief any one)

Q.9 a) Define soil survey. Explain different types of soil survey.

Ans. : *Soil survey* is a study and mapping of soils in their natural environment. It is the systematic examination, description, classification and mapping of soils of an area.

Types of soils survey

Depending upon the objective, method, type of base map available and the intensity of observations, four major types of soil surveys are recognized. They are :

1. Detailed
2. Reconnaissance
3. Detailed-reconnaissance [a combination of (1) and (2) above]
4. Semi-detailed

b) What is weathering? Explain chemical weathering (in detail).

Ans. : "*Weathering* is a process of disintegration and decomposition of rocks and minerals which are brought about by physical agents and chemical processes, leading to the formation of *regolith* (unconsolidated residues of the weathering rock on the earth's surface or above the solid rocks)".

Chemical Weathering: (Reactions under each agent required)

1. Solution 2. Hydration 3. Hydrolysis
4. Oxidation 5. Reduction and 6. Carbonation

Q.10 Write short note (Any two)

1. **Soil Pollution:**

Soil Pollutants are natural material that set wrong places or become too

concentrated in some places.

Kinds of pollutants :

1. ~~Pesticides : Herbicides, insecticides, fungicides, nematocides, rodenticides etc~~
2. Inorganic : Viz. mercury, cadmium, lead, etc.
3. Organic pollutants: Wastes from concentrated feedlots, food processing plants, municipal wastes and industrial waste
4. Salts
5. Radionuclide
6. Acid rains

Soil pollution: It relates to diffused sources, leaching, sediments and dissolved material.

Soil pollution by agrochemicals: A wide range of agro-chemicals are currently used by farmers to sustain food production. These chemicals range from fertilizers to pesticides.

Commonly used agrochemical are :

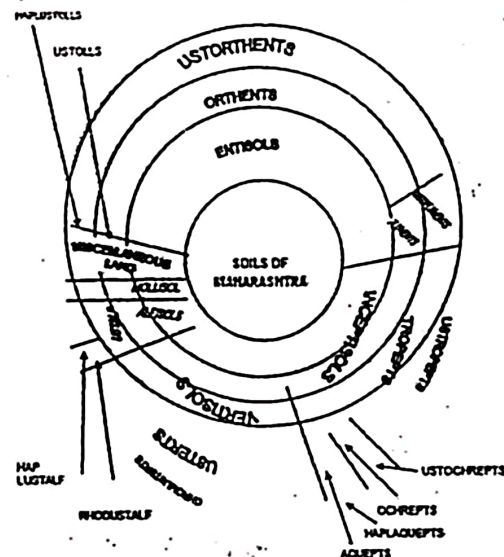
1. Fertilizers : N, P, K and other micronutrient fertilizers
2. Pesticides : Quarternary N pesticides, carboxylic herbicides, hydroxy acid pesticides, carbamates, chlorinated hydrocarbons, organophosphates, pyrethroids, thiocarbamates etc.

2. Soil of Maharashtra:

SOILS OF MAHARASHTRA

SOIL DISTRIBUTION AND CLASSIFICATION

The pictorial distribution of soils in Maharashtra under different orders, suborders, great groups, subgroups



Distribution of soils in Maharashtra

The total area under different soils is 99.6 per cent and the rest (0.4%) is occupied by miscellaneous lands. It has been observed that Entisols (36.77%), Inceptisols (30.9%) and Vertisols (26.3%) are the predominate soils following Alfisols (3.6%) and Mollisols (0.1%).

3. Cation Exchange Capacity:

The CEC is the capacity of soil to hold and exchange cations. The cation exchange capacity is defined simply as the sum total of the exchangeable cations that a soil can adsorb.

Means of Expression

The cation exchange capacity is expressed in terms of equivalents or more specifically, as mill equivalents per 100 gram and is written as meq/100g.

The old "equivalent" is represented by moles (+) or mole, which indicates a monovalent ion portion. For example, to write 12.5 meq/100 g in the newer metric system, it can be written as: 12.5 cmol (+) kg⁻¹ of soil.

4. Soil pH:

The pH represents the amount of free or acidity and not the total quantity of potential or combined acidity. pH value ranges from 0 to 14. Zero is highest limit of active acidity and 14 is the highest limit of basicity. For practical purposes, soils having pH ranging from 6.5 to 7.5 neutral. pH 6.5 to 6.0 slightly acid, 6 to 5.0 moderately acid, 5.0 to 4.0 strongly acid and less than 4 are pH 6.5 to 6.0 slightly acid, 6 to 5.0 moderately acid, 5.0 to 4.0 strongly acid and less than 4 are extremely acid. pH 7.5 to 8.0 slightly alkaline. 8 to 9 moderately alkaline, 9 to 10.0 strongly alkaline, while those greater than 10 are extremely alkaline.

Importance of Buffering to agriculture

Prevents sudden changes and fluctuations in soil pH and regulates all those activities influenced by soil reaction, nutrient availability, soil amendment required.

Significance of soil reaction in plant nutrition:

Influence on availability of plant nutrients;

Effect of plant growth

Most plants grow well when pH is 5.5 to 7.5 serious problems develop when pH is below 5.0 or rises above 9.0.

SECTION "B"

Q.11 Define following terms.

1. **Field capacity:** It is the moisture content in soil with a force of 1/3 atmosphere (bar) which is upper limit of the soil moisture available to the plant.
2. **Pedology:** The science dealing with the origin of the soil, its classification, and its description and geological distribution.
3. **Particle density:** The weight per unit volume of the solid portion of soil is called particle density.
4. **Edaphology:** Edaphology (from the Greek word *edaphos*, which means soil or ground) is the study of soil from the standpoint of higher plants
5. **Flocculation:** Aggregation of individual particles into small group or granules.
6. **Eluviation:** Removal of soil material from the upper to the lower horizon in solution or in colloidal suspension.

7. **pF:** Height of a column of water to produce necessary suction.
8. **Humus:** *Humus* is a complex and rather resistat mixture of brown or dark brown amorphous and colloidal organic substance that results from microbial decomposition and synthesis and has chemical and physical properties of great significane to soils and plants.

Q.12 Answers the points

1. Igneous rocks consolidated in vertical cracks and formed walk like masses, called Dykes.
2. Soil consistence represents at varying moisture conditions, the degree and kind of cohesion and adhesion of soil material.
3. Organic matter
4. Amygdaloidal rocks.
5. Hue is the dominant spectral colour (rainbow) and is related to wavelength of light.
6. Streak is the colour of the powder of a mineral.
7. Dokuchaev
8. Introductory Soil Science by D. K. Das and The Nature and Properties of Soil by N.C. Brady (1995). (Other reference books also be considered)