

MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION

Model Answer Sheet

B.Sc.(Ag.)

Semester : 1 (New)

Academic Year : 2019-20

Course No. : SSAC-111

Title : Fundamental of Soil Science

Credit : 2+1

Date :

Time :

Total Marks : 80

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 diagram wherever necessary.

SECTION "A"

Q.1 (a) Write the kinds of soil pollution.

(4 M)

Ans. : There are generally five different kinds of pollution namely:

(1 M)

1. **Pesticides pollution in soil**: Those are mostly used as soil application for agricultural purposes and all of which reach the soil.

e.g. Herbicides, insecticides, fungicides, nematicides, rodenticides etc.

(3 M)

2. **Inorganic contaminants or pollutants** : Mostly heavy metal pollution in the soil. viz. Mercury, cadmium, lead, etc.

3. **Organic wastes** : Those from concentrated feed lots and food processing plants along with municipal and industrial wastes, some of which may be dumped on soil.

4. **Salts** : Contamination of soils with salts is one form of soil pollution primarily agricultural in origin. The accumulation of excess salts either through the application of chemical fertilizers or through the application of irrigation water.

5. **Radio-nuclides** : The main concern with the radio-activity is the fall out of radio active materials produced from explosions and hazards associated with it. The other source of pollution is through the dumping of the waste materials from the nuclear power plants, nuclear reactors and wastes from the medical and other research laboratories.

6. **Acid rains** : Acid precipitation, popularly called *acid rain*, is apparently due to the oxidation of nitrogen and sulphur containing gases that dissolve in the water vapour of the atmosphere to form nitric and sulphuric acid.

Q.1 (b) What are the soil moisture constants ?

(4 M)

Ans. :

The amount of water that a soil contains at hygroscopic coefficient and the maximum capillary capacity equilibrium points is known as a soil moisture constant. The soil moisture constant represents definite soil moisture relationship and retention of soil moisture in the field.

(4 M)

Following are the soil moisture constants.

1) **Field capacity** : After application of water in the soil all the gravitational

water is drained away, then the wet soil is almost uniformly moist. The amount of water held by the soil at this stage, is known as field capacity.

2) **Wilting coefficient** : As the moisture content falls, a point is reached when the water is so firmly held by the soil particles that plant roots are unable to draw it. The plant begin to wilt and does not retain unless water is applied to soil. The stage at which this occurs is termed as wilting point.

3) **Hygroscopic coefficient** : The hygroscopic coefficient is the maximum amount of hygroscopic water absorbed by 100 g of dry soil under standard conditions of humidity and temperature.

Q.2 (a) Define soil aeration. Give the composition of soil air and atmospheric air. (4 M)

Ans. : The constant movement of air in the soil mass resulting in the renewal of gases is known as soil aeration. (1 M)

	Percentage by volume			(3 M)
	Nitrogen (N)	Oxygen (O ₂)	CO ₂	
Soil Air	79.2	20.60	0.30	
Atmospheric air	79.9	20.97	0.03	

Q.2 (b) State factors affecting soil temperature. (4 M)

- Ans. :**
- 1) **Soil texture** : Sandy soils generally warm up quicker than clayey or fine grained soil. A fine grained soil carry a large amount of water and for this reason also slow to warm.
 - 2) **Soil structure** : Soils having granular or crumby structure warm up more rapidly because there is no water holding.
 - 3) **Soil composition** : Mineral soil get heated more readily than organic soil.
 - 4) **Soil colour** : Dark coloured soil usually warm up more readily than light coloured soil.
 - 5) **Soil moisture** : Moist soils have a higher specific heat than dry soil. The evaporation of water rather helped to lower the temperature of a moist soil. Moist soil gets heated more slowly.
 - 6) **Slope of land** : The topography of land, more particularly the ground slope also affects the temperature of the soil.
 - 7) **Vegetation cover** : Soils that are covered with vegetation absorb less heat than those that are bare.

Q.3 (a) Write in brief about measurement of soil colour. (4 M)

Ans. : Soil colour is expressed by Munsell's colour notations using Munsell's Soil Colour Charts.

- 1) **Hue** : is the dominant spectral colour (rainbow).
 - It is related to dominant wavelength of light.
 - The hue notation of a colour indicates its relation to Red, Yellow, Green, Blue and Purple.
 - The symbol of hue is the letter abbreviation of the colour of rainbow (R for red, YR for yellow-red, Y for yellow) proceeded by numbers from 0 to 10.
 - The hue becomes more yellow and less red as the number increases.
- 2) **Value** : is the lightness or darkness of the dominant spectral colour.
 - The notation for value consists for numbers from 0/ for pure black to 10/ for pure white.

- Grey is perceived as about half way between black and white and has a value notation of 5/.
 - Lighter colours are indicated by numbers from 10/ to 5/, while darker colours are indicated by numbers from 5/ to 0/.
- 3) **Chroma** : is the purity of the dominant spectral colour.
- Chroma increases with decreasing grayness.
 - The notation for chroma consists for numbers from 0 for neutral gray and increasing at equal intervals to a maximum of 20 (which is never approached by soil).
 - In soil chroma extends from /0 for neutral to /8 for the strongest colour.

Q.3 (b) Write down the importance of soil water.

(4 M)

Ans. : (Any Four)

- 1) It serves as solvent and carrier of food nutrients for growth of plant
- 2) Yield of the crop is more obtained determined by the amount of water available rather than other food nutrients
- 3) Acts as nutrient itself
- 4) It regulates soil temperature
- 5) Soil forming processes and weathering depends on water
- 6) Micro-organisms requires water for their metabolic activities
- 7) Helps in chemical and biological activities of soil
- 8) It is principle constituents of the growing plant
- 9) It is essential for photosynthesis

Q.4 (a) State the effect of soil colour on soil condition.

(4 M)

Ans. : Effect of soil colour on soil condition :

The colour of soil has some relevance to soil constituent viz., organic matter, oxides of Fe and Mg, soil temperature, parent material and drainage

- 1) **Soil colour and organic matter** :- soils high in organic matter are black or dark coloured
- 2) **Soil colour and soil temperature** :- dark colour soils absorbs more heat. They warm up more quickly. In the spring, higher temperature.
- 3) **Soil colour and parent material** :- soils formed from mafic rocks, having usually darker soil colour and higher nutrient content than felsic parent material
- 4) **Soil colour and drainage** :- many soils have enough iron in them to turn red if they are oxidized.

Q.4 (b) Give biological classification of soil water.

(4 M)

Ans. : It is based on the availability of water to the plant and divided into three parts

- 1) **Available water** :- The available water is that water which lies between wilting coefficient and field capacity. It is obtained by subtracting wilting coefficient from moisture equivalent
- 2) **Unavailable water** :- The unavailable water includes the whole of the hygroscopic water plus a part of the capillary water below the wilting point.
- 3) **Super available water** :- the water beyond the field capacity stage is said to be super available. It includes gravitational water plus a part of capillary water. This water is unavailable for the use of plants.

Q.5 (a) Write the source of soil organic matter and give composition of plant (4 M)

residues.

Ans.: Sources of soil organic matter :

(1 M)

1) Primary source

Plants - Tops and roots of trees, shrubs, grasses, remains of harvested crops

2) Secondary source

Animals - Waste product of animals, remains of animals after completion of life cycle

Give composition of plant residues.

Plant residues content 25% dry matter and 75% water

(3 M)

Types of compounds

Elemental composition

- | | |
|--------------------------|--------|
| 1) Carbohydrates | 60% |
| a) Sugar & starches | 1-5% |
| b) Hemicelluloses | 10-30% |
| c) Celluloses | 20-50% |
| 2) Protein | 1-15% |
| 3) Fats, waxes & tannins | 1-8% |
| 4) Lignin | 10-30% |

- | | |
|-------------|-----|
| 1) Carbon | 44% |
| 2) Oxygen | 40% |
| 3) Hydrogen | 8% |
| 4) Ash | 8% |

Q.5 (b) Enlist different soil forming process. Explain one specific soil forming process in brief. (4 M)

Ans.:

Soil Forming Processes / Pedogenic Processes

(2 M)

Fundamental soil forming processes

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

Specific soil forming processes

- 1) Calcification
- 2) De-calcification
- 3) Podzolization
- 4) Laterization
- 5) Gleization
- 6) Salinization
- 7) De-salinization
- 8) Alkalization / Solonization
- 9) De-alkalization / Solodization
- 10) Pedoturbation

Explanation of one specific soil forming process in brief.

(2 M)

Q.6 a) State land capability classes.

(4 M)

Ans.: It consists of eight classes viz., Class I to Class VIII. Classes I to IV can be used for cultivation and classes V to VIII can not be cultivated in their present state under normal management.

Class - I Very good land

Class - II Good land

Class - III Moderately good land

Class - IV Fairly good land

Class - V Land suitable for pasture & grazing

Class - VI Land suitable for pasture & grazing

Class - VII Land suitable for pasture & grazing

Class - VIII Land suitable for wildlife & watershed

Q.6 b) Explain the significance of C:N ratio.

(4 M)

Ans.: The ratio of weight of organic carbon (C) to the weight of total nitrogen (N) in a soil or organic material is known as C:N ratio. When fresh plant residues are added to the soil, they are rich in carbon and poor in nitrogen. This results in wide carbon:nitrogen ratio which may be 40:1, which upon decomposition changes to 10:1.

When organic matter with a wide C:N ratio (50:1) are incorporated in the

soil, decomposition quickly occurs. Carbon dioxide is produced in large quantities and nitrogen (nitrate) disappears from the soil as microbes demand this element and very little or no nitrogen is available to the plants, consequently plant growth affected. As decomposition completed the C:N ratio decreases since carbon is being lost and nitrogen conserved and thus increase plant growth.

Q.7 a) Define soil science. What are the major disciplines or branches of soil science? (4 M)

Ans. : **Soil Science :-** The science dealing with soil as a natural resource on the surface of the earth including Pedology and physical, chemical and biological properties of soil in relation of their management for crop production. (4 M)

Discipline/ branches of Soil Science	Soil Fertility	ability of soil to supply nutrients
	Soil Chemistry	study of chemical composition, processes and properties of soil
	Soil Physics	study of physical properties of soil
	Soil Micro-biology	study of micro-organisms
	Soil Conservation	management of soil against physical loss by e
	Pedology	Study of soil genesis, survey and classificatio

Q.7 b) Write importance of cation exchange. (4 M)

Ans. :

- 1) The exchangeable K and Mg are the major source of plant K and Mg
- 2) The amount of lime required to raise the pH of an acidic soil is greater as the greater CEC
- 3) It holds Ca^{++} , Mg^{++} , K^+ , Na^+ and NH_4^+ ions and slow down their losses by leaching
- 4) It holds fertilizer K^+ and NH_4^+ and generally reduce their mobility in soils
- 5) It adsorb many metals like Cd^{++} , Zn^{++} , Ni^{++} and Pb^{++} which are present in waste water

Q.8 a) Write down the differences between particle density and bulk density. (4 M)

Ans. : (Any four differences)

Particle density	Bulk density
1) Also called as "Absolute", "Real" or "True specific gravity".	1) Also called "Apparent specific gravity".
2) Denoted by $P_s = M_s/V_s$	2) Denoted by $P_b = M_s/V_t$
3) Consist of soil solid excluding pore spaces	3) Consist of soil solid including pore spaces
4) Not affected by organic matter	4) Affected by several factors like texture, structure, organic matter etc
5) Ranges from 2.60 to 2.75 Mg m^{-3} average 2.65 Mg m^{-3}	5) Ranges from 1.10 to 1.50 Mg m^{-3} average 1.30 Mg m^{-3}
6) Estimated by Pycnometer method	6) Estimated by clod or core method
7) Stable/static method	7) Unstable/dynamic method
8) Defined as mass per unit volume of soil solids	8) Defined as mass per unit volume including pore space

Q.8 b) State the importance of soil structure. (4 M)

- Ans. :
- 1) Influences the amount and nature of porosity
 - 2) Controls amount of water and air in soil
 - 3) It affect tillage practices
 - 4) Controls runoff and erosion
 - 5) Piaty structure allows free drainage, sphere like structure helps in drainage
 - 6) Crumbly and granular structure provides optimum infiltration, water holding capacity, aeration and drainage
 - 7) Good habitat for micro-organism and supply of nutrients.

Q.9 (a) Define soil colloids and write types of soil colloids in details. (4 M)

Ans. : The clay fraction of the soil contains particles less than 0.002 mm in size. The particle less than 0.001 mm size possesses properties of typical colloidal substances like gelatin, starch, silicic acid etc. Hence these particles are known as soil colloids. (1 M)

Soil Colloids are of two types (3 M)

Inorganic colloid

- 1) commonly called as "Colloidal clay"
- 2) derived from weathering of rocks and minerals
- 3) generally observed in tropical and sub-tropical regions
- 4) they are crystalline in form
e.g. Layer silicate clays

Organic colloid

- 1) commonly called as "Humus"
- 2) derived from decomposition of plants and animal remains
- 3) generally observed in temperate regions
- 4) they are amorphous materials
e.g. Humus

Q.9 (b) Define sedimentary rock and classify in brief. (4 M)

Ans. : The sedimentary rocks are formed from sediments derived from the breaking down of pre-existing rock. The sediments are transported to new places and deposited in new arrangements and cemented to form secondary rocks. (1 M)

Based on rocks formed through a chemical reaction, sedimentary rocks are formed into following types : (3 M)

Types	Description	Example
1) Arenaceous rocks	Rocks formed by the <i>deposition of coarse grained particles</i>	Sandstone
2) Argillaceous rocks	Rocks formed by the <i>deposition of fine particles</i>	Shale, Mudstone
3) Calcareous rocks	Rocks consists of <i>carbonate of lime or lime and magnesia</i>	Limestone, Dolomite
4) Carbonaceous rocks	Rocks formed from <i>decomposing vegetation under anaerobic condition</i>	Coal, Lignite
5) Siliceous rocks	Rocks consists <i>mainly SiO_2 derived from plants and animals</i>	Diatomaceous earth
6) Precipitated rocks	Rocks consists <i>deposits formed as rock masses either by cooling, evaporation or by direct chemical precipitation</i>	Rock phosphate, Gypsum, Bauxite

Q.10 (a) Define soil structure and give its types in brief. (4 M)

Ans. : The arrangement and organization of primary and secondary particles in a soil mass is known as soil structure. (1 M)

SECTION "B"

Q.11 Match the pair

(8 M)

Part "A"

- 1) Stokes' Law
- 2) Silt and sand
- 3) Primary Mineral
- 4) Climate
- 5) Heavy mineral
- 6) Mohr's scale
- 7) Acidic rock
- 8) Intrusive

Part "B"

- d) Soil texture
- a) Skeleton of soil
- c) Feldspar
- b) Active soil forming factor
- g) Sp.Gr. > 2.85
- e) Hardness of mineral
- f) Granite
- h) Plutonic

Q.12 Fill in the blanks

(8 M)


- 1) Conversion of limestone to marble is an example of thermo-metamorphic rock.
- 2) According to International scale 0.20 to 0.02 mm diameter soil separates is called as fine sand.
- 3) The colour of the powder of the mineral is called as streak.
- 4) Soils having more than 20% of organic constituents are designated as organic soils.
- 5) The particles less than 0.001 mm size possess colloidal properties.
- 6) The solid phase of soil is also called as soil matrix.
- 7) The intrusive rocks consolidated in horizontal cracks or planes are called sills.
- 8) Topography is passive soil forming factor.


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