SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF AGRICULTURAL ENGINEERING

QUESTION BANK

III SEMESTER

AG3363–SOIL SCIENCE AND ENGINEERING

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SUBJECT CODE/NAME: 1902301–SOIL SCIENCE AND ENGINEERING
SEM/YEAR: III/II

UNIT I – INTRODUCTION AND SOIL PHYSICS			
Soil - definition - major components – Soil forming minerals and processes - soil profile-Physical properties - texture – density – porosity – consistence – colour - specific gravity- capillary and non - capillary – plasticity - Soil air - soil temperature - soil water -classification of soil water - Movement soil water - Soil colloids – organic and inorganic matter - Ion exchange- pH – Plant nutrient availability.			
PART A			
Q.NO	**QUESTIONS**	**BT LEVEL**	**COMPETENCE**
1.	Define soil.	BT-1	Remember
2.	List the major components of soil.	BT-1	Remember
3.	Name any two soil-forming minerals.	BT-1	Remember
4.	What is a soil profile?	BT-2	Understand
5.	Define soil texture.	BT-1	Remember
6.	What is bulk density?	BT-1	Remember
7.	Define porosity of soil.	BT-1	Remember
8.	What is soil consistence?	BT-2	Understand
9.	Name any two factors that influence soil color.	BT-2	Understand
10.	Define specific gravity of soil solids.	BT-2	Understand
11.	Differentiate between capillary and non-capillary pores.	BT-2	Understand
12.	What is plasticity in soils?	BT-2	Understand
13.	Define soil air.	BT-3	Apply
14.	Mention two factors affecting soil temperature.	BT-2	Understand
15.	Classify the types of soil water.	BT-1	Remember
16.	What is gravitational water?	BT-1	Remember
17.	Define field capacity and permanent wilting point.	BT-2	Understand
18.	What is infiltration?	BT-3	Apply
19.	Define percolation.	BT-3	Apply
20.	What are soil colloids?	BT-1	Remember
21.	Mention two differences between organic and inorganic colloids.	BT-1	Remember
22.	What is ion exchange capacity of soil?	BT-2	Understand
23.	Define soil pH.	BT-1	Remember
24.	State the ideal pH range for most crop plants.	BT-2	Understand

25.	How does pH affect nutrient availability in soils?	BT-1	Remember
	PART B		
1.	Define soil. Explain the major components of soil and their role in plant growth.	BT-3	Apply
2.	Discuss the soil forming processes. Explain the formation and structure of a typical soil profile.	BT-3	Apply
3.	Explain soil texture and structure. How do they affect soil properties and plant growth?	BT-3	Apply
4.	Define and explain bulk density, particle density, and porosity. Derive the relationship among them.	BT-3	Apply
5.	Explain soil colour, consistence, and specific gravity. What are their practical implications in agriculture?	BT-3	Apply
6.	Differentiate between capillary and non-capillary pores. How do they influence water retention in soil?	BT-3	Apply
7.	What is soil plasticity? Discuss Atterberg limits and their significance in soil mechanics.	BT-3	Apply
8.	Describe soil air and soil temperature. Discuss their roles in plant growth and microbial activity.	BT-3	Apply
9.	Explain the different forms of soil water with a neat diagram. Describe their availability to plants.	BT-3	Apply
10.	Explain the movement of water in soil: saturated flow, unsaturated flow, and vapour movement.	BT-3	Apply
11.	Discuss the classification of soil water based on its energy status and availability to plants.	BT-3	Apply
12.	What are soil colloids? Compare the properties of organic and inorganic colloids.	BT-3	Apply
13.	Explain ion exchange phenomena in soils. What are cation exchange capacity (CEC) and anion exchange capacity (AEC)?	BT-3	Apply
14.	Define soil pH. How is it measured? Discuss its role in nutrient availability and soil amendments.	BT-4	Analyse
15.	How does soil pH influence the availability of macronutrients and micronutrients to plants?	BT-4	Analyse
16.	Discuss the sources and roles of organic matter in soil. How does it influence soil physical and chemical properties?	BT-4	Analyse
17.	Describe the different mechanisms of water movement in soil. How are they influenced by texture and structure?	BT-4	Analyse
18.	Write short notes on: a) Field capacity and wilting point b) Diffusion and mass flow c) Soil texture triangle d) Role of soil colloids in nutrient retention	BT-3	Apply

UNIT II – SOIL CLASSIFICATION AND SURVEY

Soil taxonomy – Soils of Tamil Nadu and India. Soil survey - types and methods of soil survey –Field mapping- mapping units - base maps -preparation of survey reports - concepts and uses -land capability classes and subclasses - soil suitability – Problem soils – Reclamation.

PART A			
Q.NO	**QUESTIONS**	**BT LEVEL**	**COMPETENCE**
1.	Define soil taxonomy.	BT-1	Remember
2.	What is a soil order in USDA soil taxonomy?	BT-2	Understand
3.	Name any two soil orders found in India.	BT-3	Apply
4.	Mention two types of soils commonly found in Tamil Nadu.	BT-1	Remember
5.	Define soil survey.	BT-1	Remember
6.	What are the main objectives of a soil survey?	BT-2	Understand
7.	Name the different types of soil survey.	BT-1	Remember
8.	What is a reconnaissance soil survey?	BT-3	Apply
9.	Define detailed soil survey.	BT-2	Understand
10.	Write any two methods used for soil survey.	BT-3	Apply
11.	What is a base map in soil survey?	BT-3	Apply
12.	Define mapping unit.	BT-2	Understand
13.	What is field mapping in soil survey?	BT-3	Apply
14.	Mention the importance of aerial photographs in soil survey.	BT-3	Apply
15.	What are the components of a soil survey report?	BT-2	Understand
16.	Define land capability classification.	BT-2	Understand
17.	What is the purpose of land capability classification?	BT-3	Apply
18.	Mention any two land capability classes.	BT-3	Apply
19.	Define soil suitability.	BT-2	Understand
20.	Differentiate between land capability and soil suitability.	BT-1	Remember
21.	What are problem soils?	BT-1	Remember
22.	Mention two examples of problem soils.	BT-2	Understand
23.	What is soil reclamation?	BT-1	Remember
24.	Name one method of reclaiming saline soil.	BT-2	Understand
25.	What is the use of land evaluation in agriculture?	BT-1	Remember
PART B			
1.	Explain the USDA soil taxonomy system. Describe the six levels of classification with examples.	BT-3	Apply
2.	Discuss the major soil orders found in India and their characteristics.	BT-3	Apply
3.	Describe the soils of Tamil Nadu with their classification, distribution, and properties.	BT-3	Apply
4.	Define soil survey. Explain different types of soil survey and their applications.	BT-3	Apply
5.	Differentiate between reconnaissance and detailed soil survey. Give advantages and limitations of each.	BT-3	Apply
6.	Explain the methods used in soil survey, including field mapping, auger boring, and profile pit studies.		
7.	Discuss the process of field mapping in a soil survey. What are the tools and techniques used?	BT-3	Apply
8.	Define mapping unit. How are mapping units selected and interpreted during a soil survey?	BT-4	Analyze

9.	What are base maps? Explain the types and sources of base maps used in soil survey.	BT-3	Apply
10.	Explain the structure and preparation of a soil survey report. What are its uses?	BT-3	Apply
11.	Define land capability classification. Explain the classification system including classes I to VIII.	BT-3	Apply
12.	Differentiate between land capability classes and subclasses with examples.	BT-3	Apply
13.	Explain the concept of soil suitability. How is land evaluated for crop suitability?	BT-3	Apply
14.	Write a detailed note on the uses of soil and land capability survey in land use planning.	BT-3	Apply
15.	Define problem soils. Describe the characteristics, causes, and management of any two types (e.g., saline, sodic, acid).	BT-3	Apply
16.	Explain the reclamation methods for saline and alkali soils. Discuss chemical and biological methods.	BT-4	Analyze
17.	Discuss the economic and environmental benefits of soil survey and land capability evaluation.	BT-3	Apply
18.	Write short notes on: a) Soil orders in Tamil Nadu b) Reconnaissance vs. Detailed survey c) Role of GIS in soil mapping d) Soil suitability for rice cultivation	BT-4	Analyze

UNIT III - PHASE RELATIONSHIP AND SOILCOMPACTION

Phase relations- Gradation analysis- Atterberg Limits and Indices- Engineering Classification of soil– Soil compaction- factors affecting compaction- field and laboratory methods.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define phase diagram of soil.	BT-1	Remember
2.	What is void ratio?	BT-2	Understand
3.	Define degree of saturation.	BT-2	Understand
4.	What is water content in soil?	BT-1	Remember
5.	Define specific gravity of soil solids.	BT-1	Remember
6.	State the relation between porosity and void ratio.	BT-1	Remember
7.	What is unit weight of soil?	BT-1	Remember
8.	Define dry density and bulk density.	BT-2	Understand
9.	What is gradation of soil?	BT-2	Understand
10.	Define well-graded soil.	BT-2	Understand
11.	What is poorly graded soil?	BT-2	Understand
12.	Define Atterberg limits.	BT-1	Remember
13.	What is the liquid limit of a soil?	BT-2	Understand
14.	Define plastic limit.	BT-2	Understand
15.	What is the shrinkage limit?	BT-2	Understand
16.	What is plasticity index?	BT-2	Understand

17.	Write the equation for consistency index.	BT-2	Understand
18.	Define flow index.	BT-1	Remember
19.	Mention any two uses of Atterberg limits.	BT-2	Understand
20.	What is soil classification?	BT-3	Apply
21.	Name any two engineering classification systems for soil.	BT-3	Apply
22.	Define soil compaction.	BT-3	Apply
23.	Mention two factors affecting compaction.	BT-3	Apply
24.	What is the purpose of the Standard Proctor Test?	BT-3	Apply
25.	Write the difference between compaction and consolidation.	BT-3	Apply
PART B			
1.	Explain the phase diagram of soil. Derive the relationship between different phase components.	BT-3	Apply
2.	Define and derive expressions for: (i) Dry density (ii) Bulk density (iii) Degree of saturation (iv) Air content.	BT-3	Apply
3.	A soil sample has a bulk density of 19.5 kN/m³ and water content of 15%. Determine dry density, void ratio, and degree of saturation if specific gravity is 2.65.	BT-3	Apply
4.	Explain the different particle size distributions and their engineering significance.	BT-3	Apply
5.	Draw a typical particle size distribution curve and explain the terms: effective size, uniformity coefficient, and coefficient of curvature.	BT-4	Analyze
6.	Differentiate between well-graded, poorly graded, and gap-graded soils with sketches.	BT-4	Analyze
7.	Define Atterberg limits. Describe the procedure for determining liquid limit and plastic limit of soil.	BT-4	Analyze
8.	What are the consistency indices? Derive expressions and explain their use in soil classification.	BT-4	Analyze
9.	Explain the engineering classification of soils using the Unified Soil Classification System (USCS).	BT-4	Analyze
10.	Classify the given soil using the plasticity chart and grain size distribution data.	BT-4	Analyze
11.	What is soil compaction? Explain the purpose and significance of compaction in geotechnical engineering.	BT-4	Analyze
12.	Explain the Standard Proctor Compaction Test procedure with a neat sketch. How is MDD and OMC determined?	BT-4	Analyze
13.	Differentiate between Standard and Modified Proctor Compaction Tests. When is each used?	BT-3	Apply
14.	List and explain the various factors affecting soil compaction.	BT-3	Apply
15.	A Standard Proctor test gave the following results: water content (%) = 10, 12, 14, 16, 18; dry density (kN/m³) = 16.2, 17.4, 18.0, 17.8, 17.3. Plot the compaction curve and determine MDD and OMC.	BT-4	Analyze
16.	Discuss various field methods for compacting soil (such as rolling, tamping, and vibration). Mention where each method is suitable.	BT-3	Apply
17.	Compare laboratory compaction methods with field compaction practices. How is compaction quality controlled in the field?	BT-3	Apply
18.	Write short notes on: a) Relative compaction b) Zero air voids line	BT-4	Analyze

	c) Liquidity index d) Compaction energy		
UNIT IV - ENGINEERING PROPERTIES OF SOIL			
Shear strength of cohesive and cohesion less - Mohr-Coulomb failure theory- Measurement of shear strength, direct shear, Triaxial and vane shear test - Permeability- Coefficient of Permeability-Darcy'slaw-field and lab methods - Assessment of seepage – Compressibility – Liquefaction.			
PART A			
Q.NO	**QUESTIONS**	**BT LEVEL**	**COMPETENCE**
1.	Define shear strength of soil.	BT-1	Remember
2.	Differentiate between cohesive and cohesionless soils.	BT-2	Understand
3.	State Mohr-Coulomb failure criterion.	BT-2	Understand
4.	What is angle of internal friction?	BT-2	Understand
5.	Define cohesion in soils.	BT-2	Understand
6.	Write two assumptions of Mohr-Coulomb theory.	BT-2	Understand
7.	What is a Mohr's circle?	BT-1	Remember
8.	Mention the components of shear strength.	BT-1	Remember
9.	State the purpose of the direct shear test.	BT-1	Remember
10.	Write the advantages of the triaxial shear test.	BT-1	Remember
11.	What is unconfined compression test?	BT-1	Remember
12.	What is the purpose of the vane shear test?	BT-1	Remember
13.	Define permeability of soil.	BT-1	Remember
14.	Write the Darcy's law for one-dimensional flow.	BT-2	Understand
15.	Mention two factors affecting permeability of soil.	BT-2	Understand
16.	What is the coefficient of permeability?	BT-2	Understand
17.	Differentiate between laboratory and field permeability tests.	BT-3	Apply
18.	Name any two field methods for determining permeability.	BT-3	Apply
19.	What is seepage in soils?	BT-3	Apply
20.	Define seepage velocity.	BT-3	Apply
21.	What is a flow net?	BT-3	Apply
22.	Define coefficient of volume compressibility.	BT-3	Apply
23.	What is consolidation of soil?	BT-3	Apply
24.	What do you mean by soil liquefaction?	BT-3	Apply
25.	State one engineering problem caused by liquefaction.	BT-3	Apply
PART B			
1.	Explain the shear strength of cohesive and cohesionless soils using Mohr-Coulomb failure theory.	BT-4	Analyze
2.	Derive the Mohr-Coulomb failure criterion. Show its representation on a Mohr's circle.	BT-4	Analyze
3.	Differentiate between direct shear, triaxial shear, and vane shear tests. Explain each with a neat diagram.	BT-4	Analyze
4.	Describe the procedure of the direct shear test. Discuss its advantages and limitations.	BT-4	Analyze
5.	Explain the triaxial shear test with different drainage conditions (UU,		

	CU, CD).	BT-4	Analyze
6.	With a neat diagram, explain the vane shear test and its suitability for soft clays.	BT-3	Apply
7.	What are the factors affecting shear strength of soils? How is shear strength used in foundation design?	BT-3	Apply
8.	Define permeability. Derive Darcy's law and explain its assumptions and limitations.	BT-3	Apply
9.	Explain the constant head and falling head laboratory tests to determine permeability.	BT-4	Analyze
10.	Describe any two field methods of determining the coefficient of permeability.	BT-3	Apply
11.	A constant head permeability test was conducted on a sandy soil. The flow rate was 100 cm^3/min, the cross-sectional area of the sample was 25 cm^2, length 10 cm, and head difference was 20 cm. Compute the coefficient of permeability.	BT-3	Apply
12.	What is seepage? Explain the concept of flow nets and how they are used to assess seepage under structures.	BT-4	Analyze
13.	Describe the procedure to draw a flow net for an earth dam. Explain its applications.	BT-4	Analyze
14.	What is compressibility of soil? Explain how it is measured using oedometer test.	BT-4	Analyze
15.	Define consolidation. Differentiate between primary and secondary consolidation.	BT-4	Analyze
16.	Discuss the phenomenon of soil liquefaction. What are the conditions that favor liquefaction? How can it be prevented?	BT-4	Analyze
17.	Explain the mechanism of liquefaction with a case study (e.g., earthquake-induced). Discuss engineering measures to mitigate liquefaction.	BT-3	Apply
18.	Write short notes on: a) Cohesion and angle of internal friction b) Effective stress and its role in shear strength c) Flow net properties d) Compressibility and settlement prediction	BT-3	Apply

UNIT 5- BEARING CAPACITY AND SLOPE STABILITY

Bearing capacity of soils - Factors affecting Bearing Capacity- Shallow foundations-Terzaghis formula-BISstandards - Slope stability-Analysis of infinite and finite slopes- friction circle method- slope protection measures.

PART A

Q.NO	QUESTIONS	BT LEVEL	COMPETENCE
1.	Define bearing capacity of soil.	BT-1	Remember
2.	List the factors affecting the bearing capacity of soils.	BT-1	Remember
3.	What is ultimate bearing capacity?	BT-2	Understand
4.	Differentiate between gross and net bearing capacity.	BT-2	Understand
5.	Mention any two methods to improve the bearing capacity of soil.	BT-1	Remember
6.	Write the assumption of Terzaghi's bearing capacity theory.	BT-2	Understand
7.	What is the significance of shape factors in bearing capacity analysis?	BT-2	Understand
8.	Define safe bearing capacity.	BT-2	Understand

9.	What is the importance of BIS standards in foundation design?	BT-3	Apply
10.	Mention any two types of shallow foundations.	BT-2	Understand
11.	Define slope stability.	BT-2	Understand
12.	State two main causes of slope failure.	BT-1	Remember
13.	What is an infinite slope?	BT-3	Apply
14.	What is the critical height in infinite slopes?	BT-1	Remember
15.	Define factor of safety in slope stability analysis.	BT-1	Remember
16.	What is a finite slope? Give an example.	BT-1	Remember
17.	Write any two differences between infinite and finite slopes.	BT-3	Apply
18.	What is the friction circle method?	BT-3	Apply
19.	State two assumptions of the friction circle method.	BT-2	Understand
20.	Mention two types of slope protection measures.	BT-2	Understand
21.	What is the purpose of providing retaining walls in slopes?	BT-2	Understand
22.	Define cohesionless soil and its slope behavior.	BT-1	Remember
23.	Write any two applications of slope stability analysis.	BT-3	Apply
24.	What is the role of water in slope failures?	BT-2	Understand
25.	Write any two advantages of using geosynthetics in slope protection.	BT-2	Understand
PART B			
1.	List and explain the factors affecting bearing capacity of soil with suitable illustrations.	BT-3	Apply
2.	Discuss various types of shallow foundations with neat sketches and their applications.	BT-3	Apply
3.	Explain in detail the assumptions, derivation and limitations of Terzaghi's bearing capacity theory.	BT-3	Apply
4.	Using Terzaghi's formula, compute the ultimate and safe bearing capacity for a square footing placed at a depth of 1.5 m in sandy soil (given: $\varphi = 30°$, $\gamma = 18$ kN/m³, $c = 0$).	BT-3	Apply
5.	Compare and contrast Terzaghi's theory and BIS code recommendations for bearing capacity.	BT-3	Apply
6.	Design a shallow foundation for a given column load and soil data using BIS code. Show all steps.	BT-3	Apply
7.	Explain the methods to improve the bearing capacity of soil.	BT-3	Apply
8.	Define slope stability. Explain the various types of slope failures with neat sketches.	BT-4	Analyze
9.	Differentiate between infinite and finite slopes. Derive the factor of safety for infinite slopes in cohesive and cohesionless soils.	BT-3	Apply
10.	Analyze the stability of an infinite slope in cohesive soil and derive the expression for critical height.	BT-3	Apply
11.	Describe in detail the analysis of finite slopes using the friction circle method.	BT-3	Apply
12.	What is the friction circle method? Derive the equation used and explain the construction with a neat diagram.	BT-3	Apply
13.	A cut slope of 10 m height is made in a soil with $c = 20$ kPa, $\varphi = 25°$, $\gamma = 18$ kN/m³. Compute the factor of safety using infinite slope	BT-4	Analyze

	analysis.		
14.	List and explain various slope protection measures with neat sketches.	BT-4	Analyze
15.	Explain the role of pore water pressure and rainfall in slope instability.	BT-4	Analyze
16.	With the help of a case study, explain a slope failure incident and the measures taken.	BT-3	Apply
17.	Write short notes on: a) Critical height of slope b) Factor of safety c) Causes of slope failure d) Role of vegetation in slope stability	BT-4	Analyze
18.	List and explain the factors affecting bearing capacity of soil with suitable illustrations.	BT-4	Analyze