JHARKHAND Rai University
RANCHI

PRACTICE SET

End Semester Examination, Dec- 2025

Program: M.Sc. (Ag.) Agronomy
Semester: I
Course: Soil chemistry
Course Code: 13A.SS.501

Course Outcomes :
At the end of the course the students will be able to;

CO1 Understand chemical composition of soils, soil organic matter and experimental methods to study ion
CO2 Comprehend potassium, phosphate and ammonium fixation in soils
CO3 Know about chemistry of acid and salt affected soils.
CO4 Determine CEC and AEC of soils and pH and titrable acidity.

UNIT-I

Section: I (5 Marks) LOT

Sl. No.	Model Questions	Bloom Taxonomy	CO
1.	Define point of zero charge (PZC) and explain its significance in soil colloids	Remember	CO1
2.	Compare between inorganic and organic soil colloids with examples	Understand	CO1
3.	Define zeta potential, and how does it influence the stability of soil colloids?	Remember	CO1
4.	Summarize coagulation and flocculation in soil colloids.	Understand	CO1
5.	Explain clay–organic matter interactions and their importance in soil chemistry.	Understand	CO1

Section: II (15 Marks) (HOT)

Sl. No.	Model Questions	Bloom Taxonomy	CO
6.	Explain the principles of electrochemistry, equilibrium thermodynamics, and chemical kinetics as applied to soil chemical reactions.	Analyze	CO1
7.	Analyze the diffuse double layer theories of soil colloids and evaluate their role in colloid stability and ion exchange	Analyse	CO1
8.	Evaluate the sorption properties and electrometric behavior of soil colloids and their impact on nutrient dynamics.	Evaluate	CO1
9.	Design the fractionation of soil organic matter, and design a conceptual model showing clay–organic matter interactions influencing soil structure and fertility	Create	CO1
10.	Design a conceptual model illustrating the interactions among soil colloids, soil organic matter fractions, and ionic species in the soil solution. Explain how these interactions influence soil structure, nutrient availability, and overall soil fertility.	Create	CO1

UNIT-II

Section: I (5 Marks) LOT

Sl. No.	Model Questions	Bloom Taxonomy	CO
11.	Define cation exchange capacity (CEC) and anion exchange capacity (AEC) of soils.	Remember	(CO2)
12.	Comapre between inner-sphere and outer-sphere surface complex formation.	Understand	(CO2)
13.	Explain Donnan membrane equilibrium concept.	Understand	(CO2)
14.	Explain hysteresis in sorption–desorption of oxy-anions.	Understand	(CO2)

15.	Mention the practical significance of ion exchange processes in plant nutrition.	Remember	(CO2)

Section: II (15 Marks) (HOT)

Sl. No.	Model Questions	Bloom Taxonomy	CO
16.	Discuss the theories of cation exchange based on the law of mass action (Kerr–Vanselow, Gapon equations, and Jenny's concept).	Analyse	(CO2)
17.	Explain the adsorption isotherms and Donnan membrane equilibrium and their roles in understanding soil ion exchange phenomena.	Analyse	(CO2)
18.	Analyze the mechanisms of anion and ligand exchange**,** including PZC shift and fixation of oxy-anions in soils.	Analyse	(CO2)
19.	Evaluate the experimental methods used to study ion exchange processes and their implications for nutrient management**.**	Evaluate	(CO2)
20.	Design an experimental setup or model to study cation and anion exchange behavior in soils using clay-membrane electrodes**.** Explain how this model can be used to assess ionic activity and nutrient availability in different soil types.	Create	(CO2)

UNIT-III

Section: I (5 Marks) LOT

Sl. No.	Model Questions	Bloom Taxonomy	CO
21.	Define specific and non-specific sorption in relation to nutrient fixation in soils.	Remember	CO3
22.	List step and constant-rate potassium release, and why is it important in soil fertility studies?	Remember	CO3

23.	Explain the mechanism of phosphate fixation in acidic and calcareous soils.	Understand	CO3
24.	Explain precipitation–dissolution equilibria in soil nutrient dynamics.	Understand	CO3
25.	Mention two management practices to minimize potassium and phosphate fixation in soils.	Remember	CO3

Section: II (10 Marks) (HOT)

Sl. No.	Model Questions	Bloom Taxonomy	CO
26.	Discuss the mechanisms and factors influencing potassium**,** phosphate fixation in different soil types.	Analyse	CO3
27.	Analyse the role of specific and non-specific sorption in controlling the availability of K, P, and NH_4^+ ions to plants.	Analyse	CO3
28.	Explain the precipitation–dissolution equilibria and their significance in phosphate and ammonium retention–release behaviour in soils.	Analyse	CO3
29.	Evaluate the kinetics of potassium release (step and constant-rate K) and its implications for nutrient management in intensive cropping systems.	Evaluate	CO3
30.	Design a nutrient management strategy or experimental model integrating knowledge of K, P, and NH_4^+ fixation, sorption, and dissolution equilibria to enhance nutrient availability and use efficiency under field conditions.	Create	CO3

UNIT-IV

Section: I (5 Marks) LOT

Sl. No.	Model Questions	Bloom Taxonomy	CO
31.	Describe active acidity and potential acidity in soils with suitable examples.	Remember	CO4
32.	Define lime potential, and how is it used to determine lime requirement in acid soils?	Remember	CO4
33.	Explain subsoil acidity and its impact on root growth.	Understand	CO4
34.	Explain the chemical characteristics of salt-affected soils and their major types.	Understand	CO4
35.	Describe electrochemical changes that occur in submerged soils under flooded conditions?	Remember	CO4

Section: II (10 Marks) (HOT)

Sl. No.	Model Questions	Bloom Taxonomy	CO
36.	Discuss the chemistry of acid soils**,** distinguishing between active and potential acidity**,** and explain methods for their amelioration.	Analyse	CO4
37.	Analyse the processes leading to the formation of salt-affected soils and describe the chemical reactions involved in their reclamation using various amendments.	Analyse	CO4
38.	Evaluate the electrochemical transformations in submerged soils and their influence on nutrient availability, especially iron, manganese, and sulphur.	Evaluate	CO4
39.	Examine the role of lime potential and buffering capacity in managing soil acidity and maintaining soil fertility.	Anlayse	CO4
40.	Design an integrated soil management plan for a region affected by both acidic and saline soils, incorporating chemical	Create	CO4

	amendments, electrochemical considerations, and crop management strategies for sustainable productivity.		

Summary Sheet:

CO Wise

CO	Q. No	Marks
CO1	1-10	100
CO2	11-20	100
CO3	21-30	100
CO4	31-40	100
Total		400

Unit Wise

Unit	Q. No	Marks
Unit 1	1-10	100
Unit 2	11-20	100
Unit 3	21-30	100
Unit 4	31-40	100
Total		400

Blooms Taxonomy Level (BTL) Wise

BTL	Q. No	Marks
LOT	1-5, 11-15,21-25,31-35	100

HOT	5-10,16-20,26-30,36-40	300
Total		400

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Disclaimer: - This is a practice set. The Question in End semester examination will differ from the practice set. This practice set is meant for practice only.