



**जननायक चन्द्रशेखर विश्वविद्यालय, बलिया-277001 (उ.प्र.)**  
**Jananayak Chandrashekhar University, Ballia-277001 (U. P.)**



## **FACULTY OF AGRICULTURE**

**Course structure and Syllabus**

**Ph.D. Course work system**

**AGRICULTURAL CHEMISTRY AND SOIL SCIENCE**

**UNDER SEMESTER SYSTEM FROM**

**ACADEMIC SESSION -2019-20**



**Ph.D. (Doctor of Philosophy)**

**AGRICULTURAL CHEMISTRY AND SOIL SCIENCE**

**FACULTY OF AGRICULRE**

**SEMESTER SYSTEM**

# **FACULTY OF AGRICULRE**

## **SEMESTER SYSTEM**

### **Ph.D. course work and Syllabusfor**

## **AGRICULTURAL CHEMISTRY AND SOIL SCIENCE**

Study of soils' is the key to understand how an ecosystem works. Soil is a store house of waterand nutrients to plants, filter for effluents-wastes, home to organisms, and is critical for recycling elements vital for plant growth, as well as organic and inorganic wastes. Moreover, soil is act as physical support to life. Soil management is essential in our continued quest to increase the production of food, fodder, fiber, fuel and fertilizers while maintaining and improving the environment, and mitigating the effects of climate change. Soil is the foundation of survivalfor present and future generations. Due to overexploitation of soil resource for different purposes by the society, soil is undergoing several degradation processes, putting the soil quality at a stake, and threatening the sustainability of food productivity globally. It is nearly impossible to feed burgeoning population without maintaining soil health. Soil professionals have an important role to play in optimally managing soil resources. The Soil Scientists and soil professionals continue to enrich the lives of all human beings by improving stewardship of the soil, combating soil degradation, and ensuring the future protection and sustainable use of our air, soil, and water resources. We never think good agriculture without good soils? The future of all life is directly linked to our understanding and appreciation of soil andland management. However, new topics and also new courses have been added to infuse new blood in the area. So, there is no soil without life and no life without soil.

- All the courses have been designed/redesigned/updated as per present and future needs.
- List of Journals have been provided to keep pace with latest developments in the area.

### **Eligibility**

#### **Qualifying Examination**

Master's degree in Science/Agriculture (M.Sc./M.Sc.(Ag.) in Agricultural Chemistry and Soil Science

M.Sc.(Ag.) in Agricultural Chemistry and Soil Science

Or

M.Sc.(Ag.) in Soil Science and Agricultural Chemistry

or

M.Sc.(Ag.) in Agricultural Chemistry/Agricultural Physics/Agricultural Biochemistry

# Ph.D. Agricultural Chemistry and Soil Science

## COURSE WORK SYSTEM

### COURSE STRUCTURE, SYLLABUS/Ph.D. COURSE WORK

- |                                                                                     |                     |
|-------------------------------------------------------------------------------------|---------------------|
| 1. PAPER-1-Research Methodology and Computer Application-                           | Credits-4, MM-100   |
| 2. PAPER-2-Research and Publication Ethics                                          | Credits-2, M.M.-100 |
| 3. PAPER-3-Advances in Soil Fertility, Soil Biochemistry and Micropedology -        | Credits-4,          |
| M.M.-100                                                                            |                     |
| 4. PAPER-4- Physical Chemistry of Soils, Land Use Planning and Watershed Management | Credits-4, M.M.-100 |

Total-14 Credits and Maximum Marks-400

#### After the completion of course work

- |                                    |              |
|------------------------------------|--------------|
| 5. SYNOPSIS SEMINAR                | Satisfactory |
| 6. ORAL COMPREHENSIVE              | Satisfactory |
| 7. COURSE SEMINAR                  | Satisfactory |
| 8. THESIS PRE SUBMISSION SEMINAR   | Satisfactory |
| 9. THESIS (DOCTORAL RESEARCH WORK) | Satisfactory |
| 10. THESIS VIVA-VOCE               | Satisfactory |

#### PROPOSED REGULATIONS

Semesters/Papers	Title of the papers	Credits Hours	Theory	
			Max. Marks	Min. Marks
Paper 1	(Theory Paper)	<b>4</b>	100	40
Paper 2	(Theory Paper)	<b>4</b>	100	40
Paper 3	(Theory Paper)	<b>4</b>	100	40
Paper 4	(Theory Paper)	3	100	40
<b>Total aggregate of First Semester will be 50 %</b>			Total 14 Credits ,Max. Marks – 400, Min.Marks – 200	
SYNOPSIS SEMINAR			Satisfactory	
ORAL COMPREHENSIVE			Satisfactory	
COURSE SEMINAR			Satisfactory	
THESIS PRE-SUBMISSION SEMINAR			Satisfactory	
THESIS (DOCTORAL RESEARCH WORK)			Satisfactory	
THESIS VIVA-VOCE			Satisfactory	

#### Note-

1. The research work may be initiated as per Ph.D. ordinance.
2. The evaluation of seminar presentation and oral comprehensive examination shall be done by the departmental committee which shall be constituted by the Head of Department /Principal of College.
3. The minimum passing marks of every paper at least will be 40 % in theory and total aggregate of the semester will be 50 % minimum.

**Ph.D.COURSE WORK SYSTEM**  
**COURSE STRUCTURE–SYLLABUS of Ph.D.**  
**Agricultural Chemistry and Soil Science**

**PAPER-I:RESEARCH METHODOLOGY AND COMPUTER APPLICATION**

**4 Credits, M.M.100**

**(Common Syllabus)**

**PAPER-II-RESEARCH AND PUBLICATION ETHICS**

**CREDITS-2, M.M.-100**

(As per UGC Recommendation)

**(Common Syllabus)**

**PAPER-III:ADVANCES IN SOIL FERTILITY, SOIL BIOCHEMISTRY AND  
MICROPEDOLOGY-**

**4 Credits, M.M.100**

**UNIT I (Theory)**

Modern concepts of nutrient availability; soil solution and plant growth; nutrient response functions and availability indices. Nutrient movement in soils; nutrient absorption by plants; mechanistic approach to nutrient supply and uptake by plants; models for transformation and movement of major micronutrients in soils. Organic matter pools in soil; composition and distribution and its functions; environmental significance of humic substances; decomposition of organic residues and relation to organic matter pools. Biochemistry of the humus formation; different pathways for humus synthesis in soil; soil carbohydrates and lipids, Pedogenic evolution of soils. Pedogenic processes; stability and weathering sequences of minerals. Assessment of soil profile development by mineralogical and chemical.

**UNIT II (Theory)**

Chemical equilibrium involving nutrient ions of submerged soils. Modern concepts of fertilizer evaluation, nutrient use efficiency and nutrient budgeting. Modern concepts of fertilizer application; soil fertility evaluation techniques; role of soil tests in fertilizer use recommendations; site-specific nutrient management. Micro-pedological features of soils – their structure, fabric analysis. Monitoring physical, chemical and biological changes in soils; permanent manurial trials and long-term fertilizer experiments; soil productivity under long-term intensive cropping; direct, residual and cumulative effect of fertilizer use. Nutrient transformation and trace metal interaction with humic substances, chelation reactions in soils. Reactive functional groups of humic substances and adsorption by clay, aggregation processes; clay-organic matter complexes. Humus-pesticide interactions in soil.

**UNIT III**

Practical related on unit second, assignment and their presentation

## UNIT VI

Practical related on unit third, assignment and their presentation

### Suggested Readings

1. Barber, S.A. (1995). *Soil Nutrient Bioavailability*. John Wiley & Sons.
2. Barker, V. Allen and Pilbeam David, J. (2007). *Handbook of Plant Nutrition*. CRC / Taylor & Francis.
3. Brady, N.C. and Weil, R.R. (2012). *The Nature and Properties of Soils*. 14th Ed. Pearson Educ.
4. Cooke, G.W. (1979). *The Control of Soil Fertility*. Crossby Lockwood & Sons.
5. Epstein, E. (1987). *Mineral Nutrition of Plants - Principles and Perspectives*. International Potash Institute, Switzerland.
6. Mortvedt, J.J., Shuman, L.M., Cox, F.R. and Welch, R.M. (Eds.). (1991). *Micronutrients in Agriculture*. 2nd Ed. Soil Science Society of America, Madison.
7. Prasad, R. Power, J.F. (1997). *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
8. Stevenson, F.J. and Cole, MA. (1999). *Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients*. John Wiley & Sons.
9. Stevenson, F.J. (Ed.). (1982). *Nitrogen in Agricultural Soils*. Soil Science Society of America, Madison.
10. Beck, A.J, Jones, K.C., Hayes, M.H.B. and Mingelgrin, U. (1993). *Organic Substances in Soil and Water: Natural Constituents and their 104*
11. Gieseking, J.E. (1975). *Soil Components*. Vol. 1. *Organic Components*. Springer-Verlag.
12. Kristiansen, P., Taji, A. and Reganold, J. (2006). *Organic Agriculture: A Global Perspective*. CSIRO Publ.
13. Magdoff, F. and Weil, R.R. (2004). *Soil Organic Matter in Sustainable Agriculture*. CRC Press.
14. Mercky, R. and Mulongoy, K. (1991). *Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture*. John Wiley & Sons.
15. Paul, E.A. (1996). *Soil Microbiology and Biochemistry*. Academic Press.
16. Stevenson FJ. 1994. *Humus Chemistry – Genesis, Composition and Reactions*. John Wiley & Sons.
17. Boul, S.W., Hole, E.D., MacCraken, R.J. Southard, R.J. (1997). *Soil Genesis and Classification*. 4th Ed. Panima Publ.
18. Brewer, R. (1976). *Fabric and Mineral Analysis of Soils*. John Wiley & Sons.

## **PAPER-IV: PHYSICAL CHEMISTRY OF SOILS, LAND USE PLANNING AND WATERSHED MANAGEMENT- 4 Credits, M.M.100**

### UNIT I

Colloidal chemistry of inorganic and organic components of soils – their formation, clay organic interaction. Cation exchange equilibria-thermodynamics, empirical and diffuse double layer theory (DDL)-relationships among different selectivity coefficients; structure and properties of diffuse double layer. Common solubility equilibria, electrochemical properties of clays. Concept and techniques of land use planning; factors governing present land use. Land evaluation methods and soil-site suitability evaluation for different crops; land capability classification and constraints in application. Agro-ecological regions/sub-regions of India.

### UNIT II

Thermodynamics of nutrient transformations in soils; cationic and anionic exchange, Adsorption/desorption isotherms-Langmuir adsorption isotherm, Freundlich adsorption isotherm, normalized exchange isotherm, selective and non-selective adsorption of ions on inorganic surfaces and organic surfaces of soil materials. Water harvesting-concept, significance, types, methodology; use of harvested water in agriculture, water productivity. Watershed development/management-concept, objectives, characterization, planning, execution, community

participation and evaluation; rehabilitation of watershed; PRA; developing economically and ecologically sustainable agro-forestry systems for watershed.

### UNIT III

Practical related on unit second, assignment and their presentation

### UNIT IV

Practical related on unit third, assignment and their presentation

#### **Suggested Readings**

1. Bear, F.E.(1964). *Chemistry of the Soil*. Oxford & IBH.
2. Bolt, G.H.and Bruggenwert, M.G.M. (1978). *Soil Chemistry*. Elsevier.
3. Fried, M.and Broeshart, H. (1967). *Soil Plant System in Relation to Inorganic Nutrition*. Academic Press.
4. Jurinak, J.J. (1978). *Chemistry of Aquatic Systems*. Dept. of Soil Science & Biometeorology, Utah State Univ.
5. McBride, M.B. (1994). *Environmental Chemistry of Soils*. Oxford Univ. Press.
6. Sparks, D.L. (1999). *Soil Physical Chemistry*. 2nd Ed. CRC Press.
7. Sposito, G. (1981). *The Thermodynamics of Soil Solutions*. Oxford Univ. Press.
8. Sposito, G. (1984). *The Surface Chemistry of Soils*. Oxford Univ. Press.
9. Sposito, G. (1989). *The Chemistry of Soils*. Oxford Univ. Press.
10. Stevenson, F.J. (1994). *Humus Chemistry*. 2nd Ed. John Wiley. 103
11. All India Soil and Land Use Survey Organisation(1970). *Soil Survey Manual*. IARI, New Delhi.
12. FAO. 1976. *A Framework for Land Evaluation*, Handbook 32. FAO.
13. Sehgal, J.L., Mandal, D.K, Mandal, C.and Vadivelu, S. (1990). *Agro-Ecological Regions of India*. NBSS & LUP, Nagpur.

#### **Suggested Books**

1. All India Soil and Land Use Survey Organization(1970).*Soil Survey Manual*. IARI, New Delhi.
2. Baver, L.D., Gardner, W.H.and Gardner, W.R. (1972). *Soil Physics*. John Wiley & Sons.
3. Beck, A.J., Jones, K.C., Hayes, M.H.B. and Mingelgrin, U. (1993). *Organic Substances in Soil and Water: Natural Constituents and their Influences on Contaminant Behavior*. Royal Society of Chemistry, London.
4. Brewer, R. (1976). *Fabric and Mineral Analysis of Soils*.John Wiley & Sons.
5. Cooke, G,W. (1979). *The Control of Soil Fertility*. Crossby Lockwood & Sons.
6. Epstein, E. (1987). *Mineral Nutrition of Plants - Principles and Perspectives*.I.P I, Switzerland.
7. FAO. (1976). *A Framework for Land Evaluation*, Handbook 32. FAO.
8. Fried, M.and Broeshart, H. (1967).*Soil Plant System in Relation to Inorganic Nutrition*.Academic Press.
9. Giesecking, J.E. (1975). *Soil Components*. Vol. 1.*Organic Components*.Springer-Verlag.
10. Greenland, D.J.and Hayes, M.H.B. (1978). *Chemistry of Soil Constituents*. John Wiley & Sons.

11. Greenland, D.J. and Hayes, M.H.B. (1981). *Chemistry of Soil Processes*. John Wiley & Sons.
12. Hanks and Aschero. (1980). *Applied Soil Physics*. Springer Verlag.
13. Hillel, D. (1980). *Applications of Soil Physics*. Academic Press.
14. Hillel, D. (1980). *Environmental Soil Physics*. Academic Press.
15. Indian Society of Soil Science (2002). *Fundamentals of Soil Science*. ISSS, New Delhi.
16. Jurinak, J.J. (1978). *Chemistry of Aquatic Systems*. Dept. of Soil Science & Biometeorology, Utah State Univ.
17. Kabata-Pendias Alina, (2001). *Trace Elements in Soils and Plants*. CRC / Taylor & Francis.
18. Kannaiyan, S., Kumar, K. and Govindarajan, K. (2004) *Biofertilizers Technology*. Scientific Publ.
19. Kirkham, D. and Powers, W.L. (1972). *Advanced Soil Physics*. Wiley Interscience.
20. Kristiansen, P., Taji, A. and Reganold, J. (2006) *Organic Agriculture: A Global Perspective*. CSIRO Publ.
21. Lal, R. and Shukla, M.K. (2004). *Principles of Soil Physics*. Marcel Dekker.
22. Magdoff, F. and Weil, R.R. (2004). *Soil Organic Matter in Sustainable Agriculture*. CRC Press.
23. McBride, M.B. (1994). *Environmental Chemistry of Soils*. Oxford Univ. Press.
24. Mercky, R. and Mulongoy, K. (1991). *Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture*. John Wiley & Sons.
25. Mortvedt, J.J., Shuman, L.M., Cox, F.R. and Welch, R.M. (Eds.). (1991). *Micronutrients in Agriculture*. 2nd Ed. Soil Science Society of America, Madison.
26. Paul, E.A. (1996). *Soil Microbiology and Biochemistry*. Academic Press.
27. Prasad, R. and Power, J.F. (1997). *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
28. Sehgal, J.L., Mandal, D.K., Mandal, C. and Vadivelu, S. (1990) *Agro-Ecological Regions of India*. NBSS & LUP, Nagpur.
29. Soil Survey Staff (1998). *Keys to Soil Taxonomy*. 8th Ed. USDA & NRCS, Washington, DC.
30. Sparks, D.L. (1999). *Soil Physical Chemistry*. 2nd Ed. CRC Press.
31. Sposito, G. (1981). *The Thermodynamics of Soil Solutions*. Oxford Univ. Press.
32. Sposito, G. (1984). *The Surface Chemistry of Soils*. Oxford Univ. Press.
33. Sposito, G. (1989). *The Chemistry of Soils*. Oxford Univ. Press.
34. Stevenson, F.J. and Cole, M.A. (1999). *Cycles of Soil: Carbon, Nitrogen,*
35. Stevenson, F.J. (Ed.). (1982). *Nitrogen in Agricultural Soils*. Soil Science Society of America, Madison. 102
36. Stevenson, F.J. (1994). *Humus Chemistry – Genesis, Composition and Reactions*. John Wiley & Sons.
37. Stevenson, F.J. (1994). *Humus Chemistry*. 2nd Ed. John Wiley. 103

38. Tisdale, S.L., Nelson, W.L., Beaton, J.D. and Havlin, J.L. (2012). *Soil Fertility and Fertilizers*. 5th Ed. Macmillan Publ.
39. USDA (1974). *A Manual on Conservation of Soil and Water Handbook of Professional Agricultural Workers*. Oxford & IBH.
40. Van Olphen, H. (1977). *Introduction to Clay Colloid Chemistry*. John Wiley & Sons.
41. Wild, A. (Ed.). (1988). *Russell's Soil Conditions and Plant Growth*. 11th Ed. Longman.

#### **SUGGESTED LIST OF JOURNALS**

1. Advanced Soil Science
2. Advances in Agronomy
3. Agrochimica
4. Agriculture Science
5. Agriculture Situation in India
6. Agropedology
7. Annals of Arid Zone
8. Australian Journal of Agricultural Research
9. Australian Journal of Soil Research
10. Biology and Fertility of Soils
11. Bioresource Technology Journal
12. Canadian Journal of Soil Research
13. Canadian Journal of Agronomy
14. Cell
15. Agronomy
16. Catena
17. Clays and Clay minerals
18. Clays Research
19. Communications in Soil Science and Plant Analysis
20. Current Microbiology
21. Current Science
22. Environmental Science and Technology
23. European Journal of Soil Science
24. Field Crop Research
25. Farming
26. Geoderma
27. Horticulture
28. Indian Journal of Agricultural Sciences
29. Indian Journals of Indigenous Technology
30. Indian Journal of Fertilizers
31. International Journal of Remote Sensing
32. Journal of Environmental Quality
33. Journal of Nuclear Agriculture Biology
34. Journal of Plant Nutrition and Soil Science
35. Journal of Potassium Research
36. Journal of Progressive Science
37. Journal of Soil and Water Conservation
38. Journal of The Indian Society of Agricultural Chemists
39. Journal of The Indian Society of Remote Sensing

40. Journal of Science and Technology
41. Journal of the Indian Society of Soil Science
42. Journal Medical Science
43. Journal of Plant Physiology
44. Legume Research
45. Nature
46. Nutrient Cycling in Agro-ecosystems
47. Pulse Research
48. Plant and Soil
49. Remote Sensing
50. Science
51. Soil and Tillage Research
52. Soil Biology and Biochemistry
53. Soil Science
54. Soil Science Society of America Journal
55. Soil Use and Management
56. Water Pollution
57. Water Resources Research
58. Water, Air and Soil Pollution

