



**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 TO COME INTO FORCE FROM**  
**ACADEMIC SESSION -2018-19**



### **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 Syllabus for**  
**AGRICULTURAL CHEMISTRY AND SOIL SCIENCE**

**Course Structure for Ph.D. Agricultural Chemistry and Soil Science**  
**Under course work System**

Study of soils' is the key to understand how an ecosystem works. Soil is a store house of water and 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-P101-RESEARCH METHODOLOGY AND COMPUTER APPLICATION MM-100
2. PAPER-P102-ADVANCES IN SOIL FERTILITY, SOIL BIOCHEMISTRY AND  
MICROPEDODOLOGY M.M.-100
3. PAPER-P103- PHYSICAL CHEMISTRY OF SOILS, LAND USE PLANNING AND  
WATERSHED MANAGEMENT M.M.-100

#### After the completion of course work

4. SYNOPSIS SEMINAR Satisfactory
5. COURSE SEMINAR Satisfactory
6. THESIS PRE SUBMISSION SEMINAR Satisfactory
7. THESIS (DOCTORAL RESEARCH WORK) Satisfactory
8. THESIS VIVA-VOCE Satisfactory

## PROPOSED REGULATIONS

Semesters/Papers <b>SEMESTER I</b>	Title of the papers	Theory	
		Max. Marks	Min. Marks
Paper P101	(Theory Paper)	100	40
Paper P102	(Theory Paper)	100	40
Paper P103	(Theory Paper)	100	40
<b>Total aggregate of First Semester will be 50 %</b>		Max. Marks – 300 Min.Marks – 150	
SYNOPSIS SEMINAR		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, written 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 will be 40 % in theory and total aggregate of the semester will be 50 % minimum.

# **Ph.D.in Agricultural Chemistry and Soil Science**

## **COURSE WORK SYSTEM**

### **COURSE STRUCTURE – SYLLABUS of Ph.D COURSE WORK**

#### **PAPER-P101--RESEARCH METHODOLOGY AND COMPUTER APPLICATION M.M.100** **(Common course for all the discipline of Agriculture faculty)**

##### **UNIT I**

Importance and scope of research in agricultural. Introduction to Research Methodology: Meaning and objective of Research, Motivations in Research, Types, approaches and significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research. Defining the Research Problem: What is Research Problem?, Selecting the Problem, Necessity of and Techniques in defining the problem

##### **UNIT II**

Methods of Data Collection: Collection of Data through questionnaire and Schedules, Collection of Secondary Data, Selection of appropriate method for data collection questionnaire, successful interviewing. Survey v/s experiment. Classification and tabulation of data. Diagrammatic and Graphical representations of research results. Correlation, rank correlation, Regression analysis, partial and multiple correlation and regression, linear and nonlinear relationship. Analysis of variance, soil heterogeneity-choosing. Sampling distributions of sample mean and sample variance from Normal population, chi-Square,  $t$  and  $F$ ,  $Z$  distributions and their properties and inter relationships.

##### **UNIT III**

Analysis of variance; Basic principles of design of experiments, size and shape of plots and blocks. Basic designs-completely randomized design, randomized complete block design and Latin square design. Factorial experiments, confounding. Split plot and Strip plot design; sampling in field experiments.

##### **UNIT IV**

Computer: fundamental, programming language, data representation, application. Systems concepts -definitions, general characteristics; general systems theory; systems thinking, systems dynamics, systems behavior and systems study.

##### **UNIT V**

Scientific Communications. Importance of publishing research papers, Publishing Research paper: (a) Preliminaries, Format, Choosing Journal, (b) Title, Running Title (c) Authors: Single and Multi authorship (d) Writing Abstract (e) Introduction section (f) Materials and Methods Section (g) Results and discussion (h) Figures: Design Principles, Legends, Table components, Graphs: Types, Style, Tables v/s Graph (i) Acknowledgements (j) References: Different Styles (k) Selecting Keywords (l) Communication with the Editor, Handling Referees' Comments, Galey Proofs 5.

Writing Review Articles 6. Preparing and Delivering of Oral and Poster Presentations 7. Avoiding Plagiarism 8. Preparing documents for MoUs, Confidentiality Agreements. 9. Standard Abbreviations and Symbols

### **Suggested Readings**

1. Agresti A. 2002. *Categorical Data Analysis*. 2nd Ed. John Wiley.
2. Arnold BC, Balakrishnan N & Nagaraja HN. 1992. *A First Course in Order Statistics*. John Wiley.
3. Huber PJ. 1981. *Robust Statistics*. John Wiley.
4. Johnson NL, Kotz S & Balakrishnan N. 2000. *Continuous Univariate Distributions*. John Wiley.
5. Marek F. 1963. *Probability Theory and Mathematical Statistics*. John Wiley.
6. Rohatgi VK & Saleh AK Md. E. 2005. *An Introduction to Probability and Statistics*. 2nd Ed. John Wiley.
7. Chakrabarti MC. 1962. *Mathematics of Design and Analysis of Experiments*. Asia Publ. House.
9. Cochran WG & Cox DR. 1957. *Experimental Designs*. 2nd Ed. John Wiley.
10. Dean AM & Voss D. 1999. *Design and Analysis of Experiments*. Springer.
11. Dey A & Mukerjee R. 1999. *Fractional Factorial Plans*. John Wiley.
12. John JA & Quenouille MH. 1977. *Experiments: Design and Analysis*. Charles & Griffin.
13. Kempthorne, O. 1976. *Design and Analysis of Experiments*. John Wiley.
14. Khuri AI & Cornell JA. 1996. *Response Surface Designs and Analysis*. 2nd Ed. Marcel Dekker.
15. Montgomery DC. 2005. *Design and Analysis of Experiments*. John Wiley.
16. Raghavarao D. 1971. *Construction and Combinatorial Problems in Design of Experiments*. John Wiley.
17. Design Resources Server. *Indian Agricultural Statistics Research Institute (ICAR), New Delhi-110012, India.* [www.iasri.res.in/design](http://www.iasri.res.in/design).
18. Gomez, K.A. and Gomez, A.A. (1984) *Statistical Procedure for Agricultural Research*, John Wiley and Sons
19. Panse, V.G. and Sukhatme, P.V. (1985) *Statistical Methods for Agricultural Workers*, ICAR Pub.
20. Chandel, SRS 2006 *A Hand Book of Agricultural Statistics*, Achal Prakashan Mandir, Kanpur

## **PAPER-P102-ADVANCES IN SOIL FERTILITY, SOIL BIOCHEMISTRY AND MICROPEDOLOGY**

**M.M.100**

### **UNIT I**

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. Pedogenic evolution of soils; soil composition and characterization.

### **UNIT II**

Chemical equilibria 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 for precision agriculture. Micro-pedological features of soils – their structure, fabric analysis, role in genesis and classification.

### UNIT III

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, soil formation – factors and pedogenic processes; stability and weathering sequences of minerals. Assessment of soil profile development by mineralogical and chemical

### UNIT VI

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, adsorption of organic compounds by clay and role of organic substances in pedogenic soil aggregation processes; clay-organic matter complexes. Humus-pesticide interactions in soil.

### Suggested Readings

1. Barber SA. 1995. *Soil Nutrient Bioavailability*. John Wiley & Sons.
2. Barker V Allen & Pilbeam David J. 2007. *Handbook of Plant Nutrition*. CRC / Taylor & Francis.
3. Brady NC & Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Educ.
4. Cooke GW. 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. Kabata-Pendias Alina 2001. *Trace Elements in Soils and Plants*. CRC / Taylor & Francis.
7. Kannaiyan S, Kumar K & Govindarajan K. 2004. *Biofertilizers Technology*. Scientific Publ.
8. Mortvedt JJ, Shuman LM, Cox FR & Welch RM. (Eds.). 1991.
9. *Micronutrients in Agriculture*. 2nd Ed. Soil Science Society of America, Madison.
10. Prasad R & Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
11. Stevenson FJ & Cole MA. 1999. *Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients*. John Wiley & Sons.
12. Stevenson FJ. (Ed.). 1982. *Nitrogen in Agricultural Soils*. Soil Science Society of America, Madison. 102
13. Tisdale SL, Nelson WL, Beaton JD & Havlin JL. 1990. *Soil Fertility and Fertilizers*. 5th Ed. Macmillan Publ.
14. Wild A. (Ed.). 1988. *Russell's Soil Conditions and Plant Growth*. 11th Ed. Longman.
15. Beck AJ, Jones KC, Hayes MHB & Mingelgrin U. 1993. *Organic Substances in Soil and Water: Natural Constituents and their* 104
16. *Influences on Contaminant Behavior*. Royal Society of Chemistry, London.
17. Gieseking JE. 1975. *Soil Components*. Vol. 1. *Organic Components*. Springer-Verlag.
18. Kristiansen P, Taji A & Reganold J. 2006. *Organic Agriculture: A Global Perspective*. CSIRO Publ.
19. Magdoff F & Weil RR 2004. *Soil Organic Matter in Sustainable Agriculture*. CRC Press.
20. Merckey R & Mulongoy K. 1991. *Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture*. John Wiley & Sons.
21. Paul EA. 1996. *Soil Microbiology and Biochemistry*. Academic Press.
22. Stevenson FJ. 1994. *Humus Chemistry – Genesis, Composition and Reactions*. John Wiley & Sons.
23. Boul SW, Hole ED, MacCracken RJ & Southard RJ. 1997. *Soil Genesis and Classification*. 4th Ed. Panima Publ.
24. Brewer R. 1976. *Fabric and Mineral Analysis of Soils*. John Wiley & Sons.

**PAPER-P103 PHYSICAL CHEMISTRY OF SOILS, LAND USE PLANNING AND  
WATERSHED MANAGEMENT** **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.

**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. Common solubility equilibria, electrochemical properties of clays.

**UNIT III**

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 and their characteristics in relation to crop production

**UNIT IV**

Water harvesting-concept, significance, types, methodology; use of harvested water in agriculture to increase 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; case studies.

**Suggested Readings**

1. Bear RE. 1964. *Chemistry of the Soil*. Oxford & IBH.
2. Bolt GH & Bruggenwert MGM. 1978. *Soil Chemistry*. Elsevier.
3. Fried M & Broeshart H. 1967. *Soil Plant System in Relation to Inorganic Nutrition*. Academic Press.
4. Greenland DJ & Hayes MHB. 1981. *Chemistry of Soil Processes*. John Wiley & Sons.
5. Greenland DJ & Hayes MHB. 1978. *Chemistry of Soil Constituents*. John Wiley & Sons.
6. Jurinak JJ. 1978. *Chemistry of Aquatic Systems*. Dept. of Soil Science & Biometeorology, Utah State Univ.
7. McBride MB. 1994. *Environmental Chemistry of Soils*. Oxford Univ. Press.
8. Sparks DL. 1999. *Soil Physical Chemistry*. 2nd Ed. CRC Press.
9. Spósito G. 1981. *The Thermodynamics of Soil Solutions*. Oxford Univ. Press.
10. Spósito G. 1984. *The Surface Chemistry of Soils*. Oxford Univ. Press.
11. Spósito G. 1989. *The Chemistry of Soils*. Oxford Univ. Press.
12. Stevenson FJ. 1994. *Humus Chemistry*. 2nd Ed. John Wiley. 103
13. Van Olphen H. 1977. *Introduction to Clay Colloid Chemistry*. John Wiley & Sons.
14. All India Soil and Land Use Survey Organisation 1970. *Soil Survey Manual*. IARI, New Delhi.
15. FAO. 1976. *A Framework for Land Evaluation*, Handbook 32. FAO.

16. Sehgal JL, Mandal DK, Mandal C & Vadivelu S. 1990. *Agro-Ecological Regions of India*. NBSS & LUP, Nagpur.
17. Soil Survey Staff 1998. *Keys to Soil Taxonomy*. 8th Ed. USDA & NRCS, Washington, DC.
18. USDA 1974. *A Manual on Conservation of Soil and Water Handbook of Professional Agricultural Workers*. Oxford & IBH.

## Suggested Books

1. All India Soil and Land Use Survey Organisation 1970. *Soil Survey Manual*. IARI, New Delhi.
2. Barber SA. 1995. *Soil Nutrient Bioavailability*. John Wiley & Sons.
3. Barker V Allen & Pilbeam David J. 2007. *Handbook of Plant Nutrition*. CRC / Taylor & Francis.
4. Baver LD, Gardner WH & Gardner WR. 1972. *Soil Physics*. John Wiley & Sons.
5. Beck AJ, Jones KC, Hayes MHB & Mingelgrin U. 1993. *Organic Substances in Soil and Water: Natural Constituents and their Influences on Contaminant Behavior*. Royal Society of Chemistry, London.
6. Brewer R. 1976. *Fabric and Mineral Analysis of Soils*. John Wiley & Sons.
7. Cooke GW. 1979. *The Control of Soil Fertility*. Crossby Lockwood & Sons.
8. Epstein E. 1987. *Mineral Nutrition of Plants - Principles and Perspectives*. I.P I, Switzerland.
9. FAO. 1976. *A Framework for Land Evaluation*, Handbook 32. FAO.
10. Fried M & Broeshart H. 1967. *Soil Plant System in Relation to Inorganic Nutrition*. Academic Press.
11. Gieseking JE. 1975. *Soil Components*. Vol. 1. *Organic Components*. Springer-Verlag.
12. Greenland DJ & Hayes MHB. 1978. *Chemistry of Soil Constituents*. John Wiley & Sons.
13. Greenland DJ & Hayes MHB. 1981. *Chemistry of Soil Processes*. John Wiley & Sons.
14. Hanks and Ascherof. 1980. *Applied Soil Physics*. Springer Verlag.
15. Hillel D. 1980. *Applications of Soil Physics*. Academic Press.
16. Hillel D. 1980. *Environmental Soil Physics*. Academic Press.
17. Indian Society of Soil Science 2002. *Fundamentals of Soil Science*. ISSS, New Delhi.
18. Jurinak JJ. 1978. *Chemistry of Aquatic Systems*. Dept. of Soil Science & Biometeorology, Utah State Univ.
19. Kabata-Pendias Alina 2001. *Trace Elements in Soils and Plants*. CRC / Taylor & Francis.
20. Kannaiyan S, Kumar K & Govindarajan K. 2004. *Biofertilizers Technology*. Scientific Publ.
21. Kirkham D & Powers WL. 1972. *Advanced Soil Physics*. Wiley Interscience.
22. Kristiansen P, Taji A & Reganold J. 2006. *Organic Agriculture: A Global Perspective*. CSIRO Publ.
23. Lal R & Shukla MK. 2004. *Principles of Soil Physics*. Marcel Dekker.
24. Magdoff F & Weil RR 2004. *Soil Organic Matter in Sustainable Agriculture*. CRC Press.
25. McBride MB. 1994. *Environmental Chemistry of Soils*. Oxford Univ. Press.
26. Merckey R & Mulongoy K. 1991. *Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture*. John Wiley & Sons.



27. Mortvedt JJ, Shuman LM, Cox FR & Welch RM. (Eds.). 1991. *Micronutrients in Agriculture*. 2nd Ed. Soil Science Society of America, Madison.
28. Paul EA. 1996. *Soil Microbiology and Biochemistry*. Academic Press.
29. *Phosphorus, Sulphur, Micronutrients*. John Wiley & Sons.
30. Prasad R & Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
31. Sehgal JL, Mandal DK, Mandal C & Vadivelu S. 1990. *Agro-Ecological Regions of India*. NBSS & LUP, Nagpur.
32. Soil Survey Staff 1998. *Keys to Soil Taxonomy*. 8th Ed. USDA & NRCS, Washington, DC.
33. Sparks DL. 1999. *Soil Physical Chemistry*. 2nd Ed. CRC Press.
34. Sposito G. 1981. *The Thermodynamics of Soil Solutions*. Oxford Univ. Press.
35. Sposito G. 1984. *The Surface Chemistry of Soils*. Oxford Univ. Press.
36. Sposito G. 1989. *The Chemistry of Soils*. Oxford Univ. Press.
37. Stevenson FJ & Cole MA. 1999. *Cycles of Soil: Carbon, Nitrogen*,
38. Stevenson FJ. (Ed.). 1982. *Nitrogen in Agricultural Soils*. Soil Science Society of America, Madison. 102
39. Stevenson FJ. 1994. *Humus Chemistry – Genesis, Composition and Reactions*. John Wiley & Sons.
40. Stevenson FJ. 1994. *Humus Chemistry*. 2nd Ed. John Wiley. 103
41. Tisdale SL, Nelson WL, Beaton JD & Havlin JL. 1990. *Soil Fertility and Fertilizers*. 5th Ed. Macmillan Publ.
42. USDA 1974. *A Manual on Conservation of Soil and Water Handbook of Professional Agricultural Workers*. Oxford & IBH.
43. van Olphen H. 1977. *Introduction to Clay Colloid Chemistry*. John Wiley & Sons.
44. 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

