Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P.)

Statute No. 9, Faculty Board of Studies, Section-15 (3)

For Ph.D.(Soil Science)

Minutes of the Meeting

The first meeting of the Board of Studies for Ph.D. (Soil Science) programme is held on 14.10.2022 at 2:00 P.M. in the Dean office, faculty of Agriculture. The committee for Board of Studies of Ph. D. (Soil Science & Agricultural Chemistry) constituted as follow :-

S.N.	Name of the Members	Designation & Address	Committee position	Signature
1.	Dr. D. P. Rai	Dean, Faculty of Agriculture	Chairman	
2.	Dr. Janardan Yadav	Prof. Soil Science Deptt. of Soil Science & Ag. Chemistry Institute of Agricultural Sciences BHU Varanasi (UP)	External Expert	
3.	Dr. Pawan. Sirothia	Asso.Prof. (Soil Sci.) Head, Deptt. of NRM	Member Secretary	
4.	Dr. U.S. Mishra	Associate Prof. (Soil Sci.) Deptt. of NRM	Member	14/10/22
5.	Dr. Kusum Singh	Deputy Registrar (Academic)	Member	14/10/2022
6.	Dr. Lalit Singh	Deputy Registrar (Examination)	Member	
7.	Dr. K. K. Singh	Prof. (Ag. Ext.) Head, Deptt. of Transfer Technology	Member	
8.	Dr. H.S. Kushwaha	Prof.(Agronomy)	Member	14/10/2022
9.	Dr. S.P. Mishra	Asso.Prof. (Ag. Bioch.) Head, Deptt. Of Crop Sciences	Member	14/10/2022
10	Dr. S.S. Gautam	Associate Prof. (Agril. Statistics)	Member	
11	Dr. Y.K. Singh	Associate Prof. Deptt. of Transfer Technology	Member	
12	Dr. S. S. Singh	Asst. Prof. (Horticulture)	Member	

The Following issued were discussed:

1. Implementation of new course structure:
   The ICAR has revised and restructured Doctoral syllabi in various disciplines of agriculture and allied sciences with the view to equip the students to gain knowledge enhance their employability and skill sets towards entrepreneurship and global competitiveness. It is heartening to note that to comply various provisions of National Education Policy- 2020 due care have taken following flexible, multi-disciplinary and holistic approach while developing the syllabus and academic regulations. Further, the Teaching Assistantship has been introduced to provide experience to the Ph.D. scholars on teaching, evaluation and other related academic matters. This is an important part of doctoral training all over the world and it is expected to enrich the students.

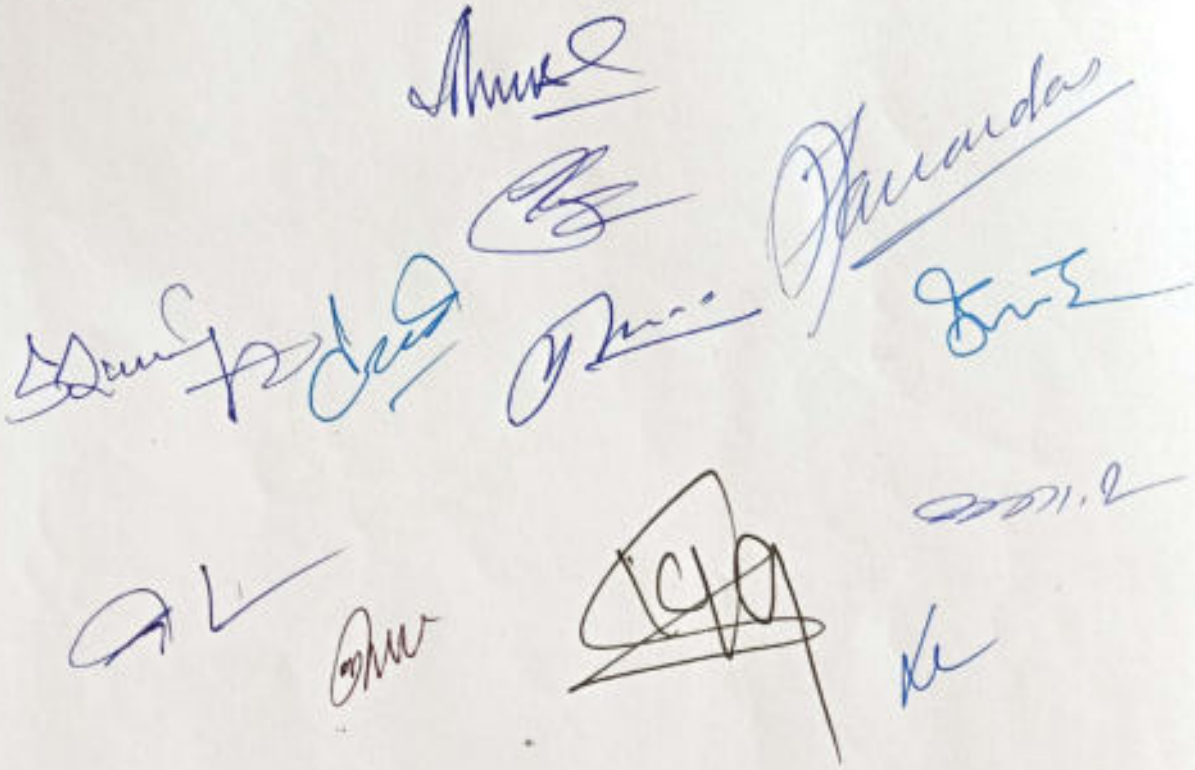
   1. All the Committee Members discussed on the name of course and suggested that, the name of Degree should be Ph.D. (Soil Science) as per the ICAR has revised restructured Doctoral on the basis of National Education Policy-2020 as per the ICAR accreditation committee report.

   2. The Course Curriculum of Ph.D (Soil Science) as per the ICAR has revised restructured Doctoral on the basis of National Education Policy-2020 as per the ICAR accreditation committee report was discussed and courses proposed have been critically examined. The committee members also discussed thoroughly semester wise breakup of the courses. The valuable advice of the members have been incorporated in the light of course breakup as per prescribed by the the ICAR has revised restructured Doctoral on the basis of National Education Policy-2020 as per the ICAR accreditation committee report. The Syllabus of Ph.D (Soil Science) courses and approved the courses and their contents.

3. All the members interacted and finally agreed for 101 credit load and same courses have been approved by the committee as given in Appendix I
4. The course curriculum will be applicable from academic session of 2022-23 Ph.D(Soil Science) and onward.
5. For Ph.D (Soil Science) programme, the registration date of commencement of first semester (date of fee deposition) is to be considered for calculating time period of degree programme.
6. The RDC (Research Development Committee) of Ph.D (Soil Science) programme is to be conducted at the end of first Semester of Ph.D. degree programme.

7. Ph.D (Soil Science) programme is to be offered abiding the rules/norms as it is stated in I.C.A.R.

The meeting ended with a vote of thanks to the esteemed external members, faculty members and the chair.



Course Curriculum of
Ph.D. Programme Agriculture

Soil Science

DEPARTMENT OF NATURAL RESOURCES MANAGEMENT
FACULTY OF AGRICULTURE
MAHATMA GANDHI CHITRAKOOT GRAMODAYA VISHWAVIDYALAYA
CHITRAKOOT, SATNA - 485334 (M.P.) INDIA

DEPARTMENT OF NATURAL RESOURCES MANAGEMENT

Ph.D. Programme
Soil Science
Semester wise course breakup
Credit Distribution of Ph.D. (Soil Science)

S.N.	Course	Credits
1	Major Courses	12
2	Minor Courses	06
3	Supporting Courses	06
4	Seminar	02
5	Thesis Research	75
	Total	**101**

Semester wise course breakup

Semester I

S.N.	Course No.	Course Title	Credits
Major Courses			
1	SOIL 602	Modern Concept in Soil Fertility	2(2+0)
3	SOIL-603	Physical Chemistry of Soils	2(2+0)
4	SOIL-604	Soil Genesis and Micro morphology	2(2+0)
Minor Courses			
5	AGRON-601	Current Trends in Agronomy	3(3+0)
Supporting Courses			
6	STAT -604	Advance Statistical Methods	3(2+1)
		Total Credit	**12 (11+1)**

Semester II

S.N.	Course No.	Name of the course	Credits
Major Courses			
1	SOIL 608	Clay Mineralogy	3(2+1)
2	SOIL-609	Recent Treads in Soil Microbial Biodiversity	3(2+1)
Minor Courses			
3	AGRON-606	Soil Conservation and Watershed Management	3(2+1)
Supporting Courses			
6	STAT - 612	Advanced Design of Experiments	3(2+1)
		Total Credit	**12(8+4)**

Semester III

S.N.	Course No.	Course Title	Credits
1.	SOIL-691	Doctoral Seminar	0+1
2.	SOIL- 699	Doctoral Research	0+25
		Total Credit	**26(0+26)**

Semester IV

S.N.	Course No.	Course Title	Credits
1.	SOIL- 692	Doctoral Seminar	0+1
2.	SOIL- 699	Doctoral Research	0+25
		Total Credit	**26 (0+26)**

Semester V

S.N.	Course No.	Course Title	Credits
1.	SOIL-699	Doctoral Research	0+25
		Total Credit	**25 (0+25)**

Semester VI

S.N.	Course No.	Course Title	Credits
1.	Thesis writing and submission		
		I,II,III,IV,V & VI Semester Total Credit	**101 (19+82)**

Note:

1. Curricula research may be given in any semester according to need.
2. For calculating time period of Ph.D. (Soil Science) degree, registration date of commencement of first semester (date of fee deposition) is to be considered for the degree programme.
3. The RDC (Research Development Committee) of Ph.D. (Soil Science) programme is to be conducted at the end of first Semester of Ph.D. degree programme.
4. Written comprehensive viz. Major and Minor Exam is to be conducted with completion of major and minor courses respectively, by Major Supervisor/Guide. The students must have cleared (60 % passing marks) Major and Minor courses offered for the degree programme.
5. Oral comprehensive exam is to be conducted in coordination of Supervisor and Advisory committee by external examiner after completion of written comprehensive.

The meeting ended with a vote of thanks to the esteemed external members, faculty members and the chair.

Semester- I

SOIL 602 – Modern Concept in Soil Fertility 2(2+0)

Course Title : **Modern Concept in Soil Fertility**
Course Code : **Soil 602**
Credit Hours : **2+0**

Aim of the course

To provide knowledge of modern concepts of soil fertility and nutrient use in cropproduction.

Theory

Unit I

Nutrient availability-concept and relationships, modern concepts of nutrient s availability; soil colloids and nutrient availability; soil amendments and availability maintenance of nutrients, soil solution and plant growth; nutrient response functionsand availability indices.

Unit II

Nutrient movement in soils; nutrient absorption by plants; mechanistic approachto nutrient supply and uptake by plants; models for transformation and movement of major micronutrients in soils.

Unit III

Chemical equilibria (including solid-solution equilbria) involving nutrientions in soils, particularly in submerged soils; Kinetic studies of nutrients in soils.

Unit IV

Modern concepts of fertilizer evaluation, nutrient use efficiency and nutrient budgeting.

Unit V

Modern concepts in fertilizer application; soil fertility evaluation techniques; role ofsoil tests in fertilizer use recommendations; site-specific nutrient management for precision agriculture.

Unit VI

Monitoring physical, chemical and biological changes in soils; permanent manorial trials and long-term fertilizer eXperiments; soil productivity under long-term intensive cropping; direct, residual and cumulative effect of fertilizer use.

Unit VII

Carbon– a nutrient central to soil fertility; carbon cycle in nature, stocks, pools and fluXes; greenhouse effect and climate change; carbon sequestration vis-à-vis sustenance of soil quality and crop productivity.

V Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

VI Learning outcome

Experience on the knowledge of soil fertility and fertilizers in relation to plant growth and development.

VIII. Suggested Reading

Barber SA. 1995. *Soil Nutrient Bioavailability*. John Wiley & Sons.

Barker V Allen and Pilbeam David J. 2007. *Handbook of Plant Nutrition*. CRC / Taylor & Francis.

Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Educ.
Cooke GW. 1979. *The Control of Soil Fertility*. Crossby Lockwood & Sons.
Epstein E. 1987. *Mineral Nutrition of Plants - Principles and Perspectives*. International Potash Institute, Switzerland.
Kabata- Pendias Alina 2001. *Trace Elements in Soils and Plants*. CRC / Taylor & Francis.
Kannaiyan S, Kumar K and Govindarajan K. 2004. *Biofertilizers Technology*. Scientific Publ.
Mortvedt JJ, Shuman LM, Cox FR and Welch RM. (Eds.). 1991. *Micronutrients in Agriculture*. 2nd Ed. Soil Science Society of America, Madison.
Prasad R and Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
Stevenson FJ and Cole MA. 1999. *Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients*. John Wiley & Sons.
Stevenson FJ. (Ed.). 1982. *Nitrogen in Agricultural Soils*. Soil Science Society of America, Madison.
Tisdale SL, Nelson WL, Beaton JD and Havlin JL. 1990. *Soil Fertility and Fertilizers*. 5th. Ed. Macmillan Publ.
Wild A. (Ed.). 1988. *Russell's Soil Conditions and Plant Growth*. 11th Ed. Longman.

SOIL-603 Physical Chemistry of Soils 2(2+0)

Course Title : **Physical Chemistry of Soil**
Course Code : **Soil 603**
Credit Hours : **2+0**

Aim of the course

To impart knowledge about modern concepts of physical chemistry of soils and clays, with emphasis on understanding the processes involved with practical significance.

Theory

Unit I

Colloidal chemistry of in organic and organic components of soils–their formation, clay organic interaction.

Unit II

Predictive approaches for cation exchange equilibria- thermodynamics, empirical and diffuse double layer theory (DDL)- relationships among different selectivity coefficients; structure and properties of diffuse double layer.

Unit III

Thermodynamics of nutrient transformations in soils; Climate change effects on minerology and surface properties of variable charge; cationic and anionic exchange and their models, molecular interaction.

Unit IV

Adsorption/desorption isotherms-Langmuir adsorption isotherm, Freundlich adsorption isotherm, normalized exchange isotherm, BET equation; selective and non-selective adsorption of ions on in organic surfaces and organic surfaces of soil materials (citation of utility in agricultural system).

Unit V

Common solubility equilibria-carbonates, ironoxide and hydroxides, aluminum silicate, aluminum phosphate; electrochemical properties of clays (citation of examples from agricultural use).

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of soil chemical behaviour on research for solving field problems.

Suggested Reading

Bear RE. 1964. *Chemistry of the Soil*. Oxford & IBH.
Bolt GH and Bruggenwert MGM. 1978. *Soil Chemistry*. Elsevier.
Fried M and Broeshart H. 1967. *Soil Plant System in Relation to Inorganic Nutrition*. Academic Press.

Greenland DJ and Hayes MHB. 1981. *Chemistry of Soil Processes*. John Wiley & Sons.
Greenland DJ and Hayes MHB. 1978. *Chemistry of Soil Constituents*. John Wiley & Sons.
Jurinak JJ. 1978. *Chemistry of Aquatic Systems*. Department of Soil Science and Biometeorology, Utah State University
McBride MB. 1994. *Environmental Chemistry of Soils*. Oxford University Press.
Sparks DL. 1999. *Soil Physical Chemistry*. 2nd Ed. CRC Press.
Sposito G. 1981. *The Thermodynamics of Soil Solutions*. Oxford University Press.
Sposito G. 1984. *The Surface Chemistry of Soils*. Oxford University Press.
Sposito G. 1989. *The Chemistry of Soils*. Oxford University Press.
Stevenson FJ. 1994. *Humus Chemistry*. 2nd Ed. John Wiley.
van Olphan H. 1977. *Introduction to Clay Colloid Chemistry*. John Wiley & Sons

SOIL-604 Soil Genesis and Micro morphology 2(2+0)

Course Title : **Soil Genesis and Micromorphology**
Course Code : **Soil 604**
Credit Hours : **2+0**

Aim of the course

To impart knowledge about the pedogenic processes in soils and to acquaint with the micro-pedagogical study of soil profile.

Theory

Unit I

Pedogenic evolution of soils; soil composition and characterization.

Unit II

Weathering and soil formation–factors and pedogenic processes; stability and weathering sequences of minerals.

Unit III

Assessment of soil profile development by mineralogical and chemical analysis.

Unit IV

Micro-pedological features of soils–their structure, fabric analysis, role in genesis and classification.

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of soil micro pedology and soil taxonomy on research for solving field problems.

Suggested Reading

Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. *Soil Genesis and Classification*. 4th Ed. Panima Publ.
Dixon JB and Weed SB. 1989. *Minerals in Soil Environments*. 2nd Ed. Soil Science Society of America, Madison.
Grim RE. 1968. *Clay Mineralogy*. McGraw Hill.
Indian Society of Soil Science 2002. *Fundamentals of Soil Science*. ISSS, New Delhi.
Sehgal J. 2002. *Introductory Pedology: Concepts and Applications*. New Delhi
Sehgal J. 2002. *Pedology - Concepts and Applications*. Kalyani.
USDA. 1999. *Soil Taxonomy*. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.
Wade FA and Mattox RB. 1960. *Elements of Crystallography and Mineralogy*. Oxford & IBH.

AGRON 601 : Current Trends in Agronomy (3+0)

Course Title : **Current Trends in Agronomy**
Course Code : **AGRON 601**
Credit Hours : **3+0**

Aim of the course

To acquaint the students about recent advances in agricultural production.

Theory

Unit I

Agro-physiological basis of variation in yield, recent advances in soilplant-water relationship.

Unit II

Globalization of agriculture and WTO, precision agriculture, contract farming, organic farming, marketing and export potential of organic products, certification, labeling and accreditation procedures and ITK in organic farming.

Unit III

Crop residue management in multiple cropping systems; latest developments in plant managementMechanizationin crop production: modern agricultural precision tools and technilogies, weed management, cropping systems, grassland management, agro-forestry, allelopathy.

Unit IV

GIS, GPS and remote sensing for crop management, global warming, GM crops, seed production technology; seed certification, seed multiplication, hybrid seedproduction etc.

Unit V

Concepts of system agriculture; holistic approach of farming systems, dryland farming, sustainable agriculture and research methodology in Agronomy. Conservation agriculture,

principles, prospects and importance, potential benefits of CA under climate change scenario, policy issues.

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Recent advances in agricultural production

Suggested Reading

Agarwal RL. 1995. *Seed Technology*. Oxford & IBH.
Dahiya BS and Rai KN. 1997. *Seed Technology*. Kalyani.
Govardhan V. 2000. *Remote Sensing and Water Management in Command Areas: Agroecological Prospectives*. IBDC.

ICAR. 2006. *Hand Book of Agriculture*. ICAR.
Narasaiah ML. 2004. *World Trade Organization and Agriculture*. Sonali Publ.
Palaniappan SP and Annadurai K. 2006. *Organic Farming - Theory and Practice*. Scientific Publ.
Sen S and Ghosh N. 1999. *Seed Science and Technology*. Kalyani.
Tarafdar JC, Tripathi KP and Kumar M. 2007. *Organic Agriculture* Scientific Publ.
Kumar, R, Swarnkar KS, Singh KS and Narayan S. 2016. *A Text Book of Seed Technology*. Kalyani Publication.
Reddy SR and Prabhakara G. 2015. *Dryland Agriculture*. Kalyani Publishers.
Gururajan B, Balasubhramanian R and Swaminath V. 2013. *Recent Strategies on CropProduction*. Kalyani Publishers.
Venkateswarlu B and Shanker Arun K. 2009. *Climate change and agriculture: Adaptation and mitigation strategies. Indian Journal of Agronomy* **54**(2): 226-230.

STAT- 604 Advanced Statistical Methods 3(2+1)

Course Title : **Advanced Statistical Methods**
Course Code : **STAT 604**
Credit Hours : **2+1**

Aim of the course

This is an advanced course in Statistical Methods that aims at describing some advanced level topics in this area of research with a very strong potential of applications. This course also prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences.

Theory

Unit I

Truncated and compound distributions. Fitting of orthogonal polynomials. Pearsonian curves.Categorical data analysis - loglinear models, Association between attributes. Variance stabilizingtransformations.

Unit II

Sampling distribution of correlation coefficient, regression coefficient, correlation ratio, intra class correlation coefficient.

Unit III

Non-central t, χ^2 and F distributions. Distribution of quadratic forms. Cochran's theorem. Tests for normality. Large sample tests. Tests of significance based on t, and F distributions. Order statistics, distribution of r^{th} order statistics, joint. distribution of several order statistics andtheir functions, marginal distributions of order statistics, distribution of range, median, etc.

Unit IV

Fitting of a generalized linear model, estimation, MINQUE, MIVQUE, REML

Practical

Fitting of truncated distribution,
Fitting of Pearsonian curves,mixed and variance components
Analysis of association between attributes, categorical data.
Fitting of non-central t, χ^2 and F distributions.
Computation of Tests of significance based on t, χ^2 and F distributions.
Order statistics.

Suggested Reading

Chatterjee S, Hadi A and Price B. 2013. *Regression Analysis by Examples*. 5th Ed. John Wiley.
Draper N.R. and Smith H. 1998. *Applied Regression Analysis*. 3rd Ed. John Wiley.
Rao C.R. 2009. *Linear Statistical Inference and its Applications*. 2nd Ed. John Wiley.
Searle S.R, Casella G and McCulloch C.E. 1992. *Variance Components*. John Wiley.
Searle S.R. 1971. *Linear Models*. John Wiley.

II[nd] Semester

SOIL-608 Clay Mineralogy (2+1)

Course Title : Clay Mineralogy
Course Code : Soil 608
Credit Hours : 2+1

Theory

Unit I

Definition and concepts of clays and clay minerals, Fundamentals of crystallography – unit cell,notations, crystal systems.

Unit II

Structures and classification of silicate minerals, basics of phyllosilicates, laws governing structural characteristics of phyllosilicates, Goldschmitdt's laws – Laws1 and Law II, Classification of Phyllosilicates.

Unit III

Kaolonite group of minerals, Dioctahedral kaolins and Trioctahedral kaolins.

Unit IV

Smectites; properties of smectites, Reference models of structure, principal types based on Hofmann-Marshal-Hendricks (H-M-H) models, occurrence of smectites, transformation and formation in soils.

Unit V

Micas: occurrence and origin in soils, polytypes of micas, structure and formation of muscovites and illite.

Unit VI

Vermicullites: structure, occurrence in soils, formation, relation between vermiculitesand montmorillonite.

Unit VII

Chlorite: occurrence and structure of chlorites, "swelling chlorites", formation of chlorite.

Unit VIII

Non-crystalline clays (amorphous materials), subgroups and chemical composition, morphology and structure, physico-chemical properties, influence of non-crystallineclays on soil properties.

Unit IX

Interstratified clay minerals, occurrence and formation in soils, regularly interstratified and partially random interstratified minerals.

Unit X

Genesis and transformation of clay minerals, Generalized conditions for formation and persistence of common clay-size minerals in soils.

Unit XI

Surface chemistry of clay minerals, clay-organic complexes, nanoclay mineralogy.

Unit XII

Clay minerals in different soil orders, role of clay minerals in soil fertility management.

Separation of clay for mineralogical study
X-ray diffraction analysis of clay
Selective dissolution of clay minerals
IR, DTA and SEM of clay minerals
Identification and quantification of clay minerals
Determination of surface charge of clay minerals
Potentiometric titration of clay minerals.
External characteristics of crystals, crystallographic

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on soil clays and utility in soil research.

Suggested Reading

Dixon JB and Weed SB (Co-editors). *Minerals in Soil Environment.*
Gieseking JE (Ed). *Soil Component*, Vol. 2. Inorganic Components.
Grim RE. *Clay Mineralogy.*
Mukherjee SK and Biswas TD (Editors). *Mineralogy of Soil Clays and Clay Minerals.*
Read HH. *Rutley's Elements of Mineralogy.*
Wilding LP and Smeck NE. 1983. *Pedogenesis and Soil Taxonomy Part II – Soil Orders.*

SOIL-609 Recent Trends in Soil Microbial Biodiversity (2+1)

Course Title : **Recent Trends in Soil Microbial Biodiversity**
Course Code : **Soil 609**
Credit Hours : **2+1**

Theory

Unit I

Microbial evaluation and biodiversity, Microbial communities in ecosystems, Newinsights in below ground diverse of plant performance.

Unit II

Qualitative ecology of microorganisms; Biomass and activities.

Unit III

Nitrogen fixing organisms, Trends in diversity of N fixing organisms. Molecularapproaches in characterising N fixing microorganisms.

Unit IV

Serology and molecular characterization, ecological aspects of bio determination,soil waste and water management

Unit V

Biodegradability, testing and monitoring of the bioremediation of pollutants and bacterial fertilizers.

Practicals

Determination of soil microbes using classical techniques.
Determination of soil microbial diversity using molecular techniques.
Estimation of soil microbial biomass carbon, nitrogen and phosphorus.
Estimation of key soil enzyme activities.
Community level physiological profiling of microbial diversity. Xerobiotic.

AGRON- 606 Soil Conservation and Watershed Management (2+1)

Course Title : **Soil Conservation and Watershed Management**
Course Code : **AGRON 606**
Credit Hours : **2+1**

Aim of the course

To teach about different soil moisture conservation technologies for enhancing the agricultural productivity through holistic approach watershed management.

Theory

Unit I

Soil erosion: definition, nature and affecting erosion. extent of erosion; types of erosion, factors.

Unit II

Soil conservation: definition, methods of soil conservation; agronomic measures - contour cultivation, strip cropping, cover crops; mulching, tillage, cropping system vegetative barriers; improved dry farming practices; mechanical measures - bunding, gully control, bench terracing; role of grasses and pastures in soil conservation; wind breaks and shelter belts.

Unit III

Watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping systems for watershed areas.

Unit IV

Land use capability classification, alternate land use systems; agro-forestry; ley farming; *jhum* management - basic concepts, socio-ethnic aspects, its layout.

Unit V

Drainage, methods of drainage, Drainage considerations and agronomic management; rehabilitation of abandoned *jhum* lands and measures to prevent soil erosion.

Practical

Study of different types of erosion
Determination of dispersion ratio

Estimation of soil loss by Universal Soil Loss Equation
Estimation of soil loss by wind erosion
Measurement of runoff and soil loss
Field studies of different soil conservation measures
Laying out run-off plot and deciding treatments
Identification of different grasses and trees for soil conservation
Visit to watershed areas
Visit to a soil conservation research centre, demonstration and training centre

Teaching methods/activities

Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome

Experience on the knowledge of soil moisture conservation technologies for enhancing the agricultural productivity through holistic approach watershed management.

Suggested Reading

Arakeri HR and Roy D. 1984. *Principles of Soil Conservation and Water Management*. Oxford& IBH.
Dhruvanarayana VV. 1993. *Soil and Water Conservation Research in India*. ICAR.
FAO. 2004. *Soil and Water Conservation in Semi-Arid Areas*. *Soils Bull.*, Paper 57.
Frederick RT, Hobbs J, Arthur D and Roy L. 1999. *Soil and Water Conservation: Productivity and Environment Protection*. 3rd Ed. Prentice Hall
Murthy VVN. 1995. *Land and Water Management Engineering*. Kalyani.
Tripathi RP and Singh HP. 1993. *Soil Erosion and Conservation*. Wiley Eastern.
Yellamanda Reddy T and Sankara Reddy GH. 1992. *Principles of Agronomy*. Kalyani.

STAT-612 Advanced Design of Experiments 3(2+1)

Course Title : **Advanced Design of Experiments**
Course Code : **STAT 612**
Credit Hours : **2+1**

Aim of the course

This is an advanced course in Design of Experiments that aims at describing some advanced level topics for students who wish to pursue research in Design of Experiments. This course prepares students for undertaking research in this area. This also helps prepare students for applications of this important subject to agricultural sciences.

Theory

Unit I

General properties and analysis of block designs. Balancing criteria. *m*-associate PBIB designs, and their association schemes including lattice designs - properties and construction, Designs for test treatment – control(s) comparisons; Nested block designs, Mating designs.Structurally Incomplete block designs

General properties and analysis of two-way heterogeneity designs, Youden type designs, generalized Youden designs, Pseudo Youdendesigns., Designs for two sets of treatments.

Unit III

Balanced factorial experiments - characterization and analysis (symmetrical and asymmetrical factorials). Factorial experiments with extra treatment(s). Orthogonal arrays, Mixed orthogonal arrays, balanced arrays, Fractional replication, Resolutionplans, Regular and irregular fractions.

Unit IV

Response surface designs - Symmetrical and asymmetrical factorials, Responseoptimization and slope estimation, Blocking, Canonical analysis and ridge analysis, CCD, Box-Jenkins, Experiments with mixtures: design and analysis. Experiments with qualitative cum quantitative factors.

Unit V

Optimality criteria and optimality of designs, robustness of designs against loss ofdata, outliers, etc. Diagnostics in design of experiments.

VI Practical

Analysis of block designs. Analysis of Latin square type designs, group divisible designs, triangular designs, lattice designs. Analysis of fractional replications of factorial experiments, analysis of asymmetrical factorials and block designs with factorial structure. Analysis of second order response surface designs.

VII Suggested Reading

Chakraborti M.C. 1962. *Mathematics of Design and Analysis of Experiments*. Asia Publ.House.

Dean A.M. and Voss D. 1999. *Design and Analysis of Experiments*.
pringer. Dey A and Mukerjee R. 1999. *Fractional Factorial Plans*. John Wiley.

Dey A 1986. *Theory of Block Designs*. Wiley Eastern.

Hall M Jr. 1986. *Combinatorial Theory*. John Wiley.

Hedayat A.S., Sloane N.J.A. and Stufken J. 1999. *Orthogonal Arrays: Theory and Applications*. Springer.

John J.A. and Quenouille M.H. 1977. *Experiments: Design and Analysis*. Charles and Griffin.

Khuri A.I. and Cornell J.A. 1996. *Response Surface Designs and Analysis*. 2nd Ed. Marcel Dekker.

Montgomery D.C. 2005. *Design and Analysis of Experiments*. John Wiley.

Ogawa J. 1974. *Statistical Theory of the Analysis of Experimental Designs*. Marcel Dekker.

Parsad R, Gupta V.K., Batra P.K., Satpati S.K. and Biswas P. 2007. *Monograph on a-designs*. IASRI, New Delhi.

Raghavarao D. 1971. *Construction and Combinatorial Problems in Design of Experiments*.
John Wiley.

Shah K.R. and Sinha B.K. 1989. *Theory of Optimal Designs. Lecture notes in Statistics*. Vol.54. Springer.

Sharma M.K. 2012. *Design and Analysis of Experiments*. Kindle Ed. 1st Ed.

Street A.P. and Street D.J. 1987. *Combinatorics of Experimental Designs*.Oxford Science Publ.

Design Resources Server: www.drs.icar.gov.in.