

FACULTY OF AGRICULTURAL SCIENCES

Syllabus

Ph.D. Soil Science & Agriculture Chemistry

(2021-22)



SHREE GURU GOBIND SINGH TRICENTENARY UNIVERSITY
GURUGRAM (DELHI-NCR)

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Eligibility Criteria for Admission to Ph.D. Agriculture

The minimum qualification for admission to Ph.D. programme shall be governed by the eligibility criteria stipulated in SGT University Common Ordinance (SGTU Regulations-2020). The candidates seeking admission in PhD must have obtained Masters Degree in concerned subject/field of specialization. There will be an entrance examination covering the syllabus prescribed by ICAR for the subject and or by the SGT University. The procedure of admission, duration of course, fee refund etc. will be governed by as per SGT University regulations. The syllabus of each subject is provided in the ordinance.

The candidates, who are awarded Fellowship by ICAR/CSIR/UGC, will be admitted to the Ph.D. programme of the University against additional seats in the concerned discipline without Entrance Test conducted by SGTU. The candidates who have not been awarded Fellowship but cleared the examination conducted by ICAR / CSIR/UGC are required to appear in the Entrance Test conducted by SGTU for admission to Ph.D. programme.

No admission in Ph.D. programme shall be made after the last date of admission.

CREDIT REQUIREMENTS:

Subject	Doctoral Program
Major	15
Minor	08
Supporting	05
Seminar	02
Research	45
Total Credits	75
Compulsory Non Credit Courses	See relevant section

Explanation:

Major subject: The subject (department) in which the student takes admission.

Minor subject: The subject closely related to student's major subject (eg. If major subject is Entomology, the appropriate minor subjects should be Plant Pathology and Nematology or as decided by the Faculty Research Committee on the recommendation of Research Advisory Committee of the student).

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for students research work.

Non-credit Compulsory Courses: Please see relevant section for details. PhD students may be exempted from these courses if already studied during Master's degree.

Service Course: A course offered for other disciplines, and not to be counted towards major credits by the department teaching that course.

NON CREDIT COMPULSORY COURSES:

Course Code	Old Code	Course Title	Credits	Semester
11060111	PGS 501	LIBRARY AND INFORMATION SERVICES	0+1	I
11060204	PGS 502	TECHNICAL WRITING AND COMMUNICATION SKILLS	0+1	II
11060205	PGS 503	INTELLECTUAL PROPERTY AND ITS	1+0	II

	(e-Course)	MANAGEMENT IN AGRICULTURE		
11060306	PGS 504 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0	III
11060106	PGS 505 (e-Course)	DISASTER MANAGEMENT	1+0	I
	HINDI-1*	Prarambhik Hindi	3+0	I, II

*Compulsory for M.Sc. or Ph.D. programmes in respect of foreign students only.

Note: One course of Statistics (3 credit) is compulsory at Ph.D. (if not studied statistics course in Master's programme).

11060111	Library & information services	0+1	Sem- I, II
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Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

11060204	Technical writing & communication skills	0+1	Sem- I, II
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Objective

- To equip the students/scholars with skills to write dissertations, research papers, etc.
- To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship, contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of (iv) numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.

Collins' Cobuild English Dictionary. 1995. Harper Collins.
 Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
 Gupta RH. 2010. Essentials of Communication. 7th Ed. Pragati Prakashan.
 Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
 James HS. 1994. Handbook for Technical Writing. NTC Business Books.
 Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
 Mohan K. 2005. Speaking English Effectively. MacMillan India.
 Richard WS. 1969. Technical Writing. Barnes & Noble.
 Robert C. (Ed.). 2005. Spoken English: Flourish Your Language.
 Abhishek. Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.

11060205	Intellectual property & its management in agriculture (e-Course)	1+0	Sem-I, II
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Objective

The main objective of this course is to equip students and stake holders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPS and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and bio-diversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

Erbisch FH & Maredia K. 1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
 Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw- Hill.
 Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.
 Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
 Rothschild M & Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
 Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.
 The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

11060306	Agricultural research, research ethics & rural development programmes (e-Course)	1+0	Sem- I, II
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Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programs and policies of Government.

Theory

UNIT I:

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II:

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III:

Concept and connotations of rural development, rural development policies and strategies. Rural development programs: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP), Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programs. Constraints in implementation of rural policies and programs.

Suggested Readings

Bhalla GS & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.

Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.

Singh K.. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

11060106	Disaster management (e-Course)	1+0	Sem- I, II
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Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion.

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. Disaster Management. Indian National Science Academy.

Orient Blackswan. Hodgkinson PE & Stewart M. 1991. Coping with Catastrophe: A Handbook of Disaster Management.

Sharma VK. 2001. Disaster Management. National Centre.

SOIL SCIENCE

Course Code	Old Code	Course Title	Credits	Semester
11020111*	SOILS 601*	ADVANCES IN SOIL PHYSICS	3+0	II
11020112*	SOILS 602*	ADVANCES IN SOIL FERTILITY	3+0	II
11020113*	SOILS 603*	PHYSICAL CHEMISTRY OF SOILS	2+0	II
11020114*	SOILS 604*	SOIL GENESIS AND MICROPEDOLOGY	2+0	I
11020115*	SOILS 605*	BIOCHEMISTRY OF SOIL ORGANIC MATTER	2+0	I
11020116	SOILS 606	LAND USE PLANNING AND WATERSHED MANAGEMENT	2+0	I
11020108	SOILS 691	DOCTORAL SEMINAR I	1	I, II
11020109	SOILS 692	DOCTORAL SEMINAR II	1	I, II
11020110	SOILS 699	DOCTORAL RESEARCH	45	
		SERVICE COURSE		
11020117	ABM 519	FERTILIZER TECHNOLOGY AND MANAGEMENT	2+0	I

*Compulsory courses.

11020111	Advances in soil physics	3+0	Sem- I
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Objective

To provide knowledge of modern concepts in soil physics.

Theory

UNIT-I

Soil-water interactions, soil water potential, free energy and thermodynamic basis of potential concept, chemical potential of soil water and entropy of the system.

UNIT-II

Fundamentals of fluid flow, Poiseuilles law, Laplace's equation, Darcy's law in saturated and unsaturated flows; development of differential equations in saturated and unsaturated water flow, capillary conductivity and diffusivity; limitations of Darcy's law; numerical solution for one dimensional water flow.

UNIT-III

Theories of horizontal and vertical infiltration under different boundary conditions.

UNIT-IV

Movement of salts in soils, models formiscible-immiscible displacement, diffusion, mass flow and dispersion of solutes and their solutions through differential equations; break-through curves.

UNIT-V

Soil air and aeration, mass flow and diffusion processes; thermal properties of soil, heat transfer in soils, differential equation of heat flow, measurement of thermal conductivity of soil.

UNIT-VI

Soil crust and clod formation; structural management of puddle drice soils; soil conditioning concept, soils conditioners-types, characteristics, working principles, significance in agriculture.

UNIT-VII

Solar and terrestrial radiation measurement, dissipation and distribution in soil-crop systems; prediction of evapo-transpiration using aerodynamic and canopy temperature-based models; canopy temperature and leaf diffusion resistance in relation to plant water deficit; evaluation of soil and plant water status using infra-red thermometer.

Suggested Readings:

Baver LD, Gardner WH & Gardner WR. 1972. Soil Physics. John Wiley & Sons. Hanks and Ascheroft. 1980. Applied Soil Physics. Springer Verlag.

Hillel D. 1980. Applications of Soil Physics. Academic Press. Hillel D. 1980. Environmental Soil Physics. Academic Press.

Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS, New Delhi. Kirkham D & Powers WL. 1972. Advanced Soil Physics. Wiley Interscience.

Lal R & Shukla MK. 2004. Principles of Soil Physics. Marcel Dekker. Oswal MC. 1994. Soil Physics. Oxford & IBH.

11020112	Advances in soil fertility	3+0	Sem- I
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Objective

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

Theory

UNIT-I

Modern concepts of nutrient availability; soil solution and plant growth; nutrient response functions and availability indices.

UNIT-II

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.

UNIT-III

Chemical equilibria (including solid-solution equilibria) involving nutrient ions in soils, particularly in submerged 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 of soil tests in fertilizer use recommendations; site-specific nutrient management for precision agriculture.

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.

Suggested Readings:

- Barber SA. 1995. Soil Nutrient Bioavailability. John Wiley & Sons.
- Barker V Allen & Pilbeam David J. 2007. Handbook of Plant Nutrition. CRC/Taylor & Francis.
- Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13thEd. Pearson Educ. Cooke GW. 1979. The Control of Soil Fertility. Crosby 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 & Govindarajan K.2004. Biofertilizers Technology. Scientific Publ.
- Mortvedt JJ, Shuman LM, Cox FR & Welch RM. (Eds.). 1991. Micronutrients in Agriculture. 2ndEd. Soil Science Society of America, Madison.
- Prasad R & Power JF. 1997. Soil Fertility Management for Sustainable Agriculture. CRC Press.
- Stevenson FJ & 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 & Havlin JL. 1990. Soil Fertility and Fertilizers. 5th Ed. Macmillan Publ.
- Wild A. (Ed.). 1988. Russell's Soil Conditions and Plant Growth. 11thEd. Longman.

11020113	Physical chemistry of soils	2+0	Sem- I
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Objective

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 inorganic 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; 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 inorganic surfaces and organic surfaces of soil materials (citation of utility in agricultural system).

UNIT-V

Common solubility equilibria-carbonates, iron oxide and hydroxides, aluminum silicate, aluminum phosphate; electro-chemical properties of clays (citation of examples from agricultural use).

Suggested Readings:

- Stevenson FJ & 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.
- Bear RE. 1964. Chemistry of the Soil. Oxford & IBH.
- Bolt GH & Bruggenwert MGM. 1978. Soil Chemistry. Elsevier.
- Fried M & Broeshart H. 1967. Soil Plant System in Relation to Inorganic Nutrition. Academic Press.
- Greenland DJ & Hayes MHB. 1981. Chemistry of Soil Processes. John Wiley & Sons.
- Greenland DJ & Hayes MHB. 1978. Chemistry of Soil Constituents. John Wiley & Sons.
- Jurinak JJ. 1978. Chemistry of Aquatic Systems. Dept. Of Soil Science & Biometeorology, Utah State Univ.
- McBride MB. 1994. Environmental Chemistry of Soils. Oxford Univ. Press.
- Sparks DL. 1999. Soil Physical Chemistry. 2ndEd. CRC Press.
- Sposito G. 1981. The Thermodynamics of Soil Solutions. Oxford Univ. Press.
- Sposito G. 1984. The Surface Chemistry of Soils. Oxford Univ. Press.
- Sposito G. 1989. The Chemistry of Soils. Oxford Univ. Press.
- Stevenson FJ. 1994. Humus Chemistry. 2nd Ed. John Wiley.
- VanOlphan H. 1977. Introduction to Clay Colloid Chemistry. John Wiley & Sons.

11020114	Soil genesis & micro-pedology	2+0	Sem-II
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Objective

To impart knowledge about the pedogenic processes in soils and to acquaint with the micro-pedological 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.

Suggested Readings:

- Boul SW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publ.
- Brewer R. 1976. Fabric and Mineral Analysis of Soils. John Wiley & Sons.

11020115	Biochemistry of soil organic matter	2+0	Sem -I
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Objective

To impart knowledge related to chemistry and reactions of organic substances and their significance in soils.

Theory

UNIT-I

Organic matter pools in soil; composition and distribution of organic matter in soil and its functions; environmental significance of humic substances; decomposition of organic residues in soil in relation to organic matter pools.

UNIT-II

Biochemistry of the humus formation; different pathways for humus synthesis in soil; soil carbohydrates and lipids.

UNIT-III

Nutrient transformation – N, P, S; trace metal interaction with humic substances, significance of chelation reactions in soils.

UNIT-IV

Reactive functional groups of humic substances, adsorption of organic compounds by clay and role of organic substances in pedogenic soil aggregation processes; lay-organic matter complexes.

UNIT-V

Humus-pesticide interactions in soil, mechanisms.

Suggested Readings

- Beck AJ, Jones KC, Hayes MHB & Mingelgrin U. 1993. Organic Substances in Soil and Water: Natural Constituents and their 104 Influences on Contaminant Behavior. Royal Society of Chemistry, London.
- Gieseking JE. 1975. Soil Components. Vol.1. Organic Components. Springer-Verlag.
- Kristiansen P, Taji A & Reganold J. 2006. Organic Agriculture: A Global Perspective. CSIRO Publ.
- Magdoff F & Weil RR 2004. Soil Organic Matter in Sustainable Agriculture. CRC Press.
- Mercky R & Mulongoy K. 1991. Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture. John Wiley & Sons.
- Paul EA. 1996. Soil Microbiology and Biochemistry. Academic Press.
- Stevenson FJ. 1994. Humus Chemistry–Genesis, Composition and Reactions. John Wiley & Sons.
- Stevenson FJ. 1994. Humus Chemistry–Genesis, Composition and Reactions. John Wiley & Sons.

11020116	Land use planning and watershed management	2+0	Sem - I
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Objective

To teach the better utilization of land for agricultural purposes, and better management of run-off or surplus/ excessive rain-water in the catchment area for agricultural purposes in a watershed.

Theory

UNIT-I

Concept and techniques of land use planning; factors governing present land use.

UNIT-II

Land evaluation methods and soil-site suitability evaluation for different crops; land capability classification and constraints in application.

UNIT-II

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.

UNIT-V

Watershed development/ management-concept, objectives, characterization, planning, execution, community participation and evaluation; rehabilitation of watershed; PRA; developing economically and ecologically sustainable agro-forestry.

Suggested Readings:

All India Soil and Land Use Survey Organisation 1970. Soil Survey Manual. IARI, New Delhi.

FAO.1976.A Framework for Land Evaluation, Handbook 32. FAO.

Sehgal JL, Mandal DK, Mandal C & Vadivelu S.1990. Agro-Ecological Regions of India. NBSS & LUP, Nagpur.

Soil Survey Staff 1998. Keysoil Taxonomy. 8th Ed. USDA & NRCS, Washington, DC.

USDA 1974. A Manual on Conservation of Soil and Water Handbook of Professional Agricultural Workers. Oxford & IBH.

Minor subject:

Agronomy may be taken as minor subject as decided by the advisory committee of the student after the approval of HOD/Dean. However, other subjects may be taken as minor depending on the requirement of research problem.

Supporting subject:

Course Code (ICAR pattern)	Course Code (SGTU pattern)	Course Title	Credits
STAT 512	11060203	EXPERIMENTAL DESIGNS	3(2+1)
STAT 513	11060308	SAMPLING TECHNIQUES	3(2+1)

11060203: EXPERIMENTAL DESIGNS 3(2+1)

Objective

This course is meant for students of agricultural and other related sciences. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

UNIT-I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.

UNIT-II

Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT-III

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT-IV

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, Lattice design, Response surfaces.

UNIT-V

Bioassays- direct and indirect, potency estimation.

Practical

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD; Analysis of factorial experiments without and with confounding; Analysis with missing data; Split plot and strip plot designs; Transformation of data; Fitting of response surfaces and Bioassays.

Suggested Readings

- Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley. Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer. Federer WT. 1985. Experimental Designs. MacMillan.
- Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publication
- Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley.
- Design Resources Server: [www.iasri.res.in /design](http://www.iasri.res.in/design).

11060308: SAMPLING TECHNIQUES 3(2+1)

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. The students would be exposed to elementary sampling techniques. It would help them in understanding the concepts

involved in planning and designing their surveys, presentation of survey data analysis of survey data and presentation of results. This course would be especially important to the students of social sciences.

Theory

UNIT-I

Concept of sampling, sample survey vs complete enumeration, planning of sample survey, sampling from a finite population.

UNIT-II

Simple random sampling, sampling for proportion, determination of sample size; inverse sampling, Stratified sampling.

UNIT-III

Cluster sampling, PPS sampling, Multi-stage sampling, double sampling, systematic sampling; Use of auxiliary information at estimation as well as selection stages.

UNIT-IV

Ratio and regression estimators. Construction and analysis of survey designs, sampling and non-sampling errors; Preparation of questionnaire Non-sampling errors.

Practical

Random sampling ~ use of random number tables, concepts of unbiasedness, variance, etc.; simple random sampling, determination of sample size; Exercises on inverse sampling, stratified sampling, cluster sampling and systematic sampling; Estimation using ratio and regression estimators; Estimation using multistage design, double sampling and PPS sampling.

Suggested Readings

- Cochran WG. 1977. Sampling Techniques. John Wiley.
- Murthy MN. 1977. Sampling Theory and Methods. 2nd Ed. Statistical Publ. Soc., Calcutta.
- Singh D, Singh P & Kumar P. 1982. Handbook on Sampling Methods. IASRI Publ.
- Sukhatme PV, Sukhatme BV, Sukhatme S & Asok C. 1984. Sampling Theory of Surveys with Applications. Iowa State University Press and Indian Society of Agricultural Statistics, New Delhi.

SGT UNIVERSITY

PROGRAMME OF WORK FOR POST-GRADUATE STUDENTS (Ph.D.)

To be submitted by HOD

To

The Dean
Faculty of Agricultural Sciences,
SGTU, Budhera, Gurugram, NCR-Delhi

The Advisory Committee of-----, son/daughter of Sh. -----& Smt. -----
-----, Registration No. ----- admitted in the ----- in **Ph.D.** programme of
Faculty of Agricultural Sciences during academic year ----- Semester ----, after consulting
him/her in a meeting, makes the following statements and recommendations:

His/Her major field is:

His/Her field of specialization is:

His/Her minor field is:

His/Her academic qualifications prior to joining this programme are:

Degree	Year of passing	Aggregate %age/ OCPA/Division	Institution	Major Subject
Sr. Secondary				
B.Sc. (Hons.) Agri.				
M.Sc. Agri.				

Head of Department

Name of Student: -----

Registration No. -----

He/She shall be required to complete the following Courses:

Classification of Courses	S. No.	Course No.	Title of the course	Credit Hours
(i) Deficiencies to be completed, if any (non credit)	1.			
	2.			
	3.			
	4.			
(ii) Major	1.			
	2.			
	3.			
	4.			
	5.			
	6.			
	7.			
	8.			
	9.			
(iii) Supporting	1.			
	2.			
(iv) Minor	1.			
	2.			
	3.			

Signature of the student

Name of Student: -----

Registration No. -----

ADVISORY COMMITTEE

S. No.	Name	Designation & Department	Signature
1.	(Major Advisor)		
2.	(Co- Major Advisor)		
3.	(Member Minor Subject)		
4.	(Member Supporting Subject)		
5.	(Nominee of Dean)		

Certified that:

1. The courses shown under deficiency, major, supporting and minor fields are according to the Ordinance
2. The titles and credit hours shown against each course are correct as per Ordinance.
3. The major and minor fields conform to those approved and mentioned in the Ordinance.
4. The Advisory Committee is in accordance with the provisions of the Ordinance.

(Major Advisor)

(Head of the Department)

Forwarded, in quintuplicate, to the Dean, FASC, SGTU, Budhera, Gurugram, NCR-Delhi.

Head of the Department

For office use

Recommended and forwarded to the Dean/Director of Research in quintuplicate.

Dean

Approved

**Dean/Director of Research
(With Seal)**

CC: Registrar, Dean (FASC), HOD, Major Advisor