

Faculty of Agriculture Science & Technology
Department of Agriculture Science

Study and Evaluation Scheme

Of

**M. Sc. (Ag) SOIL SCIENCE AND
AGRICULTURAL CHEMISTRY**

(Applicable w.e.f Academic Session 2014-16 till revised)



AKS UNIVERSITY, SATNA

Study and Evaluation Scheme

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modifications to this syllabus as deemed necessary**

M. Sc. (Ag) Soil Science and Agricultural Chemistry
(Two Year Master Degree Programme)
Requirement of credit hours for award of the degree

S.No	Nature of courses	Credit hours
1	Major courses	20
2	Minor courses	09
3	Supporting courses	06
4	Master Seminar	01
5	Master Research	20
	Total credits	56

Major Subject: The subject (Department/Discipline) in which a student takes admission

Minor Subject: The subject closely related to a student's major subject.

Supporting subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work or necessary for building his overall competence.

Non-Credit compulsory Courses: Six courses (PGS 1 –PGS 6) are of general nature and are compulsory for the students in many purpose.

Master's programme
M. Sc.(Ag) Soil Science and Agricultural Chemistry
Semester-wise distribution of courses

First Semester

A. Major courses*			
S.No.	Courses Code	Title of Course	Credit hours
1	SSC 502	Soil Fertility and Fertilizer Use	4(3+1)
2	SSC 506	Soil Biology and Biochemistry	3(2+1)
3	SSC 509	Soil, Water and Air Pollution	3(2+1)
		Total	10(7+3)
B. Minor courses**			
1	AGR 513	Principles and Practices of Organic Farming	3(2+1)
2	PPH 501	Principles of Plant physiology	3(2+1)
		Total	6 (4+2)
C. Supporting courses***			
1	STAT 511	Statistical Methods in Applied Science	3(2+1)
		Total	3(2+1)
D. Non credit course			
1	PGS 502	Technical Writing and Communication Skill	N.C.
2	PGS 503	Intellectual Property and Its Management in Agriculture	N.C.
		Grand Total	19

Second Semester

A. Major courses*			
S.No	Courses Code	Title of Course	Credit hours
1	SSC 501	Soil Physics	3(2+1)
2	SSC 503	Soil Chemistry	3(2+1)
3	SSC 504	Soil Mineralogy, Genesis, Classification and Survey	3(2+1)
4	SSC 514	Fertilizer Technology	1(1+0)
		Total	10(7+3)
B. Minor courses**			
1	AGR 512	Dry land farming and watershed management	3(2+1)
		Total	3(2+1)
C. Supporting courses***			
1	STAT 512	Experimental design	3(2+1)
		Total	3(2+1)
D. Non credit course			
1	PGS 504	Library and information services	N.C.
2	PGS 501	Basic Concepts in Laboratory Techniques	N.C.
		Grand Total	16

Third Semester

A. Major courses*			
S.No	Courses Code	Title of Course	Credit hours
1	SSC 591	Master Seminar	1(1+0)
2	SSC 599	Master's Research	10(0+10)
		Total	11 (1+10)
B. Non Credit Course**			
1	PGS 506	Disaster Management	N.C.
	Total		N.C.
		Grand Total	

Fourth Semester

A. Major courses*			
S.No	Courses Code	Title of Course	Credit hours
1	SSC 599	Master's Research Seminar	10(0+10)
		Total	10(0+10)

SSC: 502 SOIL FERTILITY AND FERTILIZER USE 4(3+1)

Objective

To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency.

Theory

UNIT I Soil fertility and soil productivity; nutrient sources-fertilizers and manures; essential plant nutrients - functions and deficiency symptoms. Soil and fertilizer nitrogen-sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation - types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

UNIT II Soil and fertilizer phosphorus-forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions. Potassium-forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions.

UNIT III Sulphur-source, forms, fertilizers and their behavior in soils; calcium and magnesium- factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

UNIT IV Common soil test methods for fertilizer recommendations; quantity- intensity relationships; soil test crop response correlations and response functions.

UNIT V Fertilizer use efficiency; blanket fertilizer recommendations-usefulness and limitations; site-specific nutrient management; plant need based nutrient management; integrated nutrient management. Soil fertility evaluation- biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

Practical

- Principles of colorimetry
- Flame-photometry and atomic absorption spectroscopy
- Chemical analysis of soil for total and available nutrients
- Analysis of plants for essential elements

Suggested Readings

- ❖ Brady NC & Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
- ❖ Kabata-Pendias A & Pendias H. 1992. *Trace Elements in Soils and Plants*. CRC Press.
- ❖ Kannaiyan S, Kumar K & Govindarajan K. 2004. *Biofertilizers Technology*. Scientific Publ.
- ❖ Leigh JG. 2002. *Nitrogen Fixation at the Millennium*. Elsevier.
- ❖ Mengel K & Kirkby EA. 1982. *Principles of Plant Nutrition*. International Potash Institute, Switzerland.
- ❖ Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. *Micronutrients in Agriculture*. 2nd Ed. SSSA, Madison.
- ❖ Pierzinsky GM, Sims TJ & Vance JF. 2002. *Soils and Environmental Quality*. 2nd Ed. CRC Press.
- ❖ Stevenson FJ & Cole MA. 1999. *Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients*. John Wiley & Sons.
- ❖ Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999. *Soil Fertility and Fertilizers*. 5th Ed. Prentice Hall of India.
- ❖ Troeh FR & Thompson LM. 2005. *Soils and Soil Fertility*. Blackwell

SSC: 506 SOIL BIOLOGY AND BIOCHEMISTRY 3(2+1)

Objective

To teach students the basics of soil biology and biochemistry, including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities.

Theory

UNIT I Soil biota, soil microbial ecology, types of organisms in different soils; soil microbial biomass; microbial interactions; un-culturable soil biota.

UNIT II Microbiology and biochemistry of root-soil interface; phyllosphere; soil enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora.

UNIT III Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients.

UNIT IV Biodegradation of pesticides, organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil.

UNIT V Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost. Biofertilizers—definition, classification, specifications, method of production and role in crop production.

Practical

- Determination of soil microbial population
- Soil microbial biomass
- Elemental composition, fractionation of organic matter and functional groups
- Decomposition of organic matter in soil
- Soil enzymes
- Measurement of important soil microbial processes such as ammonification, nitrification, N₂ fixation, S oxidation, P solubilization and mineralization of other micro nutrients
- Study of rhizosphere effect

Suggested Readings

- ❖ Alexander M. 1977. *Introduction to Soil Microbiology*. John Wiley & Sons.
- ❖ Burges A & Raw F. 1967. *Soil Biology*. Academic Press.
- ❖ McLaren AD & Peterson GH. 1967. *Soil Biochemistry*. Vol. XI. Marcel Dekker.
- ❖ Metting FB. 1993. *Soil Microbial Ecology – Applications in Agricultural and Environmental Management*. Marcel Dekker.
- ❖ Paul EA & Ladd JN. 1981. *Soil Biochemistry*. Marcel Dekker.
- ❖ Reddy MV. (Ed.). *Soil Organisms and Litter in the Tropics*. Oxford & IBH.
- ❖ Russel RS. 1977. *Plant Root System: Their Functions and Interaction with the Soil*. ELBS & McGraw Hill.
- ❖ Stotzky G & Bollag JM. 1993. *Soil Biochemistry*. Vol. VIII. Marcel Dekker.
- ❖ Sylvia DN. 2005. *Principles and Applications of Soil Microbiology*. Pearson Edu.
- ❖ Wild A. 1993. *Soil and the Environment - An Introduction*. Cambridge Univ. Press.

SSC: 509 SOIL, WATER AND AIR POLLUTION 3(2+1)

Objective

To make the students aware of the problems of soil, water and air pollution associated with use of soils for crop production.

Theory

UNIT I Soil, water and air pollution problems associated with agriculture, nature and extent.

UNIT II Nature and sources of pollutants—agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings.

UNIT III Sewage and industrial effluents—their composition and effect on soil properties / health, and plant growth and human beings; soil as sink for waste disposal.

UNIT IV Pesticides—their classification, behavior in soil and effect on soil microorganisms. Toxic elements—their sources, behavior in soils, effect on nutrients availability, effect on plant and human health.

UNIT V Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases—carbon dioxide, methane and nitrous oxide. Remediation / amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

Practical

- Sampling of sewage waters, sewage sludge, solid/liquid industrial wastes, polluted soils and plants
- Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD), nitrate and ammoniacal nitrogen and phosphorus, heavy metal content in effluents
- Heavy metals in contaminated soils and plants
- Management of contaminants in soil and plants to safeguard food safety
- Air sampling and determination of particulate matter and oxides of sulphur
- Visit to various industrial sites to study the impact of pollutants on soil and plants

Suggested Readings

- ❖ Lal R, Kimble J, Levine E & Stewart BA. 1995. *Soil Management and Greenhouse Effect*. CRC Press.
- ❖ Middlebrooks EJ. 1979. *Industrial Pollution Control*. Vol. I. *Agro- Industries*. John Wiley Interscience.
- ❖ Ross SM. *Toxic Metals in Soil Plant Systems*. John Wiley & Sons.
- ❖ Vesilund PA & Pierce 1983. *Environmental Pollution and Control*. Ann Arbor Science Publ.
- ❖ Dhruv Narayan VV. 2002. *Soil and Water Conservation Research in India*. ICAR.
- ❖ Gupta US. (Ed.). 1995. *Production and Improvements of Crops for Drylands*. Oxford & IBH.
- ❖ Katyaj JC & Farrington J. 1995. *Research for Rainfed Farming*. CRIDA.
- ❖ Rao SC & Ryan J. 2007. *Challenges and Strategies of Dryland Agriculture*. Scientific Publishers.
- ❖ Singh P & Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publishing Company.
- ❖ Singh RP. 1988. *Improved Agronomic Practices for Dryland Crops*. CRIDA.
- ❖ Singh RP. 2005. *Sustainable Development of Dryland Agriculture in India*. Scientific Publ.
- ❖ Singh SD. 1998. *Arid Land Irrigation and Ecological Management*. Scientific Publishers.
- ❖ Venkateswarlu J. 2004. *Rainfed Agriculture in India. Research and Development Scenario*. ICAR.

SSC: 501 SOIL PHYSICS 3(2+1)

. Objective

To impart basic knowledge about soil physical properties and processes in relation to plant growth.

Theory

UNIT I Scope of soil physics and its relation with other branches of soil science; soil as a three phase system.

UNIT II Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts.

UNIT III Soil structure-genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation.

UNIT IV Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential. Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

UNIT V Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

Practical

- Mechanical analysis by pipette and international methods
- Measurement of Atterberg limits
- Aggregate analysis - dry and wet
- Measurement of soil-water content by different methods
- Measurement of soil-water potential by using tensiometer and gypsum blocks
- Determination of soil-moisture characteristics curve and computation of pore-size distribution
- Determination of hydraulic conductivity under saturated and unsaturated conditions
- Determination of infiltration rate of soil
- Determination of aeration porosity and oxygen diffusion rate
- Soil temperature measurements by different methods
- Estimation of water balance components in bare and cropped fields

Suggested Readings :

- ❖ Baver LD, Gardner WH & Gardner WR. 1972. *Soil Physics*. John Wiley & Sons.
- ❖ Ghildyal BP & Tripathi RP. 2001. *Soil Physics*. New Age International.
- ❖ Hanks JR & Ashcroft GL. 1980. *Applied Soil Physics*. Springer Verlag.
- ❖ Hillel D. 1972. *Optimizing the Soil Physical Environment toward Greater Crop Yields*. Academic Press.
- ❖ Hillel D. 1980. *Applications of Soil Physics*. Academic Press.

- ❖ Hillel D. 1980. *Fundamentals of Soil Physics*. Academic Press.
- ❖ Hillel D. 1998. *Environmental Soil Physics*. Academic Press.
- ❖ Hillel D. 2003. *Introduction to 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.
- ❖ Kohnke H. 1968. *Soil Physics*. McGraw Hill.
- ❖ Lal R & Shukla MK. 2004. *Principles of Soil Physics*. Marcel Dekker.
- ❖ Oswal MC. 1994. *Soil Physics*. Oxford & IBH.
- ❖ Saha AK. 2004. *Text Book of Soil Physics*. Kalyani

SSC: 504 SOIL MINERALOGY, GENESIS, CLASSIFICATION AND SURVEY 3(2+1)

Objective

To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals; soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning.

Theory

UNIT I Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism.

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils.

UNIT II Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils.

UNIT III Concept of soil individual; soil classification systems–historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness.

UNIT IV Soil survey and its types; soil survey techniques-conventional and modern; soil series-characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps.

UNIT V Landform-soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT) – concept and application; approaches for managing soils and landscapes in the framework of agro-ecosystem.

Practical

- Identification and quantification of minerals in soil fractions
- Morphological properties of soil profile in different landforms
- Classification of soils using soil taxonomy
- Calculation of weathering indices and its application in soil formation
- Grouping soils using available data base in terms of soil quality
- Aerial photo and satellite data interpretation for soil and land use
- Cartographic techniques for preparation of base maps and thematic maps, processing of field sheets, compilation and obstruction of maps in different scales
- Land use planning exercises using conventional and RS tools

Suggested Readings

- ❖ Brady NC & 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 & 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 & Mattox RB. 1960. *Elements of Crystallography and Mineralogy*. Oxford & IBH.

SSC: 514 FERTILIZER TECHNOLOGY 1(1+0)

Objective

To impart knowledge about how different fertilizers are manufactured using different kinds of raw materials and handling of fertilizers and manures.

Theory

UNIT I Fertilizers – production, consumption and future projections with regard to nutrient use in the country and respective states; fertilizer control order.

UNIT II Manufacturing processes for different fertilizers using various raw materials, characteristics and nutrient contents.

UNIT III Recent developments in secondary and micronutrient fertilizers and their quality control as per fertilizer control order.

UNIT IV New and emerging issues in fertilizer technology – production and use of slow and controlled release fertilizers.

UNIT V Supergranules fertilizers and fertilizers for specific crops / situations.

Suggested Readings

- ❖ Brady NC & Weil RR. 2002. *The Nature and Properties of Soils*. Pearson Edu.
- ❖ *Fertilizer (Control) Order, 1985 and the Essential Commodities Act*. FAI New Delhi.
- ❖ Kanwar JS. (Ed.). 1976. *Soil Fertility: Theory and Practice*. ICAR.
- ❖ Olson RA, Army TS, Hanway JJ & Kilmer VJ. 1971. *Fertilizer Technology and Use*. 2nd Ed. Soil Sci. Soc. Am. Madison.
- ❖ Prasad R & Power JF. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
- ❖ Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999. *Soil Fertility and Fertilizers*. McMillan Publ.
- ❖ Vogel AI. 1979. *Textbook of Quantitative Inorganic Analysis*. ELBS

AGRO: 513 PRINCIPLES AND PRACTICES OF ORGANIC FARMING 2(1+1)

Objective:

To study the principles and practices of organic farming for sustainable crop production.

Theory

UNIT I- Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.

UNIT II- Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

UNIT III- Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

UNIT IV- Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

UNIT V- Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical

- Aerobic and anaerobic methods of making compost.
- Making of vermicompost.
- Identification and nursery raising of important agro-forestry trees and trees for shelter belts.
- Efficient use of biofertilizers, technique of treating legume seeds with Rhizobium cultures, use of Azotobacter, Azospirillum, and PSB cultures in field.
- Visit to an organic farm.
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms.

Suggested Readings

- ❖ Lampin N. 1990. Organic Farming. Press Books, Ipswich, UK.
- ❖ Palaniappan SP & Anandurai K. 1999. Organic Farming—Theory and Practice.
- ❖ Sharma A. 2002. Hand Book of Organic Farming. Agrobios.
- ❖ Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.
- ❖ Trivedi RN. 1993. A Text Book of Environmental Sciences, Anmol Publ.
- ❖ Veeresh GK, Shivashankar K & Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture.

AGR: 512 DRYLAND FARMING AND WATERSHED MANAGEMENT 3(2+1)

Objective

To teach the basic concepts and practices of dry land farming and soil moisture conservation.

Theory

UNIT I- Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture.

UNIT II- Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.

UNIT III- Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

UNIT IV- Tillage, tillth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants; soil and crop management techniques, seeding and efficient fertilizer use.

UNIT V- Concept of watershed resource management, problems, approach and components.

Practical

- Seed treatment, seed germination and crop establishment in relation to soil moisture contents
- Moisture stress effects and recovery behaviour of important crops
- Estimation of moisture index and aridity index
- Spray of anti-transpirants and their effect on crops
- Collection and interpretation of data for water balance equations
- Water use efficiency
- Preparation of crop plans for different drought conditions
- Study of field experiments relevant to dryland farming
- Visit to dryland research stations and watershed projects

Suggested Readings

- ❖ Das NR. 2007. Tillage and Crop Production. Scientific Publishers.
- ❖ Dhopte AM. 2002. Agrotechnology for Dryland Farming. Scientific Publ.
- ❖ Dhruv Narayan VV. 2002. Soil and Water Conservation Research in India. ICAR.
- ❖ Gupta US. (Ed.). 1995. Production and Improvements of Crops for Drylands. Oxford & IBH.
- ❖ Katyaj JC & Farrington J. 1995. Research for Rainfed Farming. CRIDA.
- ❖ Rao SC & Ryan J. 2007. Challenges and Strategies of Dryland Agriculture. Scientific Publishers.
- ❖ Singh P & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishing Company.
- ❖ Singh RP. 1988. Improved Agronomic Practices for Dry land Crops. CRIDA.
- ❖ Singh RP. 2005. Sustainable Development of Dry land Agriculture in India. Scientific Publ.
- ❖ Singh SD. 1998. Arid Land Irrigation and Ecological Management. Scientific Publishers.
- ❖ Venkateshwarlu J. 2004. Rainfed Agriculture in India. Research and Development Scenario. ICAR.

APP: 501 PRINCIPLES OF CROP PHYSIOLOGY 3(2+1)

Objective:

To acquaint the students with the basic concepts of plant physiology and their application in agriculture.

Theory

UNIT I Soil and plant water relations, water and its role in plants, properties and functions of water in the cell water relations-, water potential of plant cells.

UNIT 2 Mechanism of water uptake by roots-transport in roots, Transpiration, factor influencing transpiration rate and theory of transpiration.

UNIT 3 Stomata structure and function–mechanism of stomatal movement, antitranspirants. The role of mineral nutrients in plant metabolism: Essential elements, classification based on function of elements in plants

UNIT 4 Photosynthesis and its importance in plant . Photochemical process, photochemical reactions, CO₂ reduction in Calvin cycle, Carbon fixation in C₄,C₃ and CAM plants and its significance.

UNIT 5 Growth and differentiation. Hormonal concept of growth and differentiation,plant growth hormones and their physiological role. Plant growth regulators, growth retardants., physiology of flowering- Photoperiodism and Vernalisation

Practical

- ❖ Measurement of soil water status.
- ❖ Measurement of transpiration rate.
- ❖ Stomatal physiology, influence of ABA on stomatal closing.
- ❖ Deficiency symptoms of nutrients.
- ❖ To study about different growth regulators.
- ❖ Demonstration of photoperiodic response of plants in terms of flowering.

Suggested Readings

- ❖ Hopkins WG & Huner NPA. 2004. *Introduction to Plant Physiology*.
- ❖ John Wiley & Sons. Salisbury FB & Ross C. 1992.
- ❖ *Plant Physiology*. 4th Ed. Wadsworth Publ. Taiz L & Zeiger E. 2006.
- ❖ *Plant Physiology*. 4th Ed. Sinauer Associat.

STAT 511: STATISTICAL METHODS FOR APPLIED SCIENCES 3(2+1)

Objective

It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I Classification, tabulation and graphical, representation of data. Box-plot, Descriptive statistics. Exploratory data analysis;

UNIT II Measures of central tendency- Mean, Median, Mode, Geometric mean, Harmonic mean.

UNIT III Measures of Dispersion- Range, Quartile deviation, Mean deviation, Standard deviation.

UNIT IV Theory of probability. Random variable and mathematical expectation. Discrete and continuous probability distributions. Correlation and regression

UNIT V Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.

Practical

Exploratory data analysis, Box-Cox plots; Fitting of distributions~Binomial, Poisson, Negative Binomial, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions-chi square, t and F; Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution; Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis; Nonparametric tests.

Suggested Readings

- ❖ Anderson TW. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.
- ❖ Goon AM, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I
- ❖ Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I.
- ❖ Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley.

STAT: 512 EXPERIMENTAL DESIGNS 3(2+1)

Objective

This course is meant for students of agricultural and animal sciences other than Statistics. 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, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT V Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays 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; Analysis of resolvable designs; Fitting of response surfaces.

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 Publ. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. Design Resources Server: www.iasri.res.in/design.

PGS: 503 Intellectual Property and Its management in Agriculture 1(1+0)

Objective

The main objective of this course is to equip students and stakeholders 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 knowledgebased 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 biodiversity 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.

PGS 502: Technical Writing and Communications Skills 1(0+1)

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

Technical Writing 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 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. 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. Wren PC & Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

PGS 504: Basic Concepts in Laboratory Techniques 1(0+1)

Objective:

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical:

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vial caps; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agrochemical doses in field and pot applications; Preparation of solutions of acids; Neutralization of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press. Gabb MH & Latchem WE.1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.8. FMPE 503: Testing and Evaluation of Tractors and Farm Equipment

PGS 501: Library and Information Services 1(0+1)

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; ere sources access methods.

PGS: 506 Disaster Management 1(1+0)

Objective

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. Routledge. Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India. 16 FMPE 595: Industry / Institute Training.