

**Faculty of Agriculture Science & Technology**

**Department of Agriculture Science**

**Study and Evaluation Scheme**

**Of**

**M. Sc. (Ag) AGRONOMY**

(Applicable w.e.f Academic Session 2015-17, till revised)



**AKS UNIVERSITY, SATNA**

**Study and Evaluation Scheme**

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**M. Sc. (Ag) Agronomy**  
**(Two Year Master Degree Programme)**  
**Requirement of credit hours for award of the degree**

<b>S.No</b>	<b>Nature of courses</b>	<b>Credit hours</b>
<b>1</b>	<b>Major courses</b>	<b>23</b>
<b>2</b>	<b>Minor courses</b>	<b>05</b>
<b>3</b>	<b>Supporting courses</b>	<b>06</b>
<b>4</b>	<b>P.G. Seminar</b>	<b>01</b>
<b>5</b>	<b>Master Research</b>	<b>20</b>
	<b>Total credits</b>	<b>55</b>

**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 are of general nature and are compulsory for Master's programme.

**M. Sc.(Ag) Agronomy**  
**Semester-wise distribution of courses**

**First Semester**

<b>A. Major courses*</b>			
<b>S.No.</b>	<b>Courses Code</b>	<b>Title of Course</b>	<b>Credit hours</b>
1	Agro 501	Modern concept in crop production	2(2+0)
2	Agro 502	Principles and practices of soil fertility and nutrient management	3(2+1)
3	Agro 506	Agronomy of major cereals, pulses and Fodder Crop	3(2+1)
4	Agro 513	Principles and practices of Organic Farming	2(1+1)
5	Agro 511	Cropping system and sustainable agriculture	1(1+0)
	Total		11(8+3)
<b>B. Minor courses**</b>			
1	APP 501	Principles of Plant physiology	3(2+1)
	Total		3(2+1)
<b>C. Supporting courses***</b>			
1	A.STAT 511	Statistical methods in applied Science	3(2+1)
	Total		3(2+1)
<b>D. Non credit course</b>			
1	PGS 502	Technical Writing and communication skill	N.C.
2	PGS 503	Intellectual Property and Its management in Agriculture	N.C.
	Grand Total		17(13+4)

## M. Sc.(Ag) Agronomy

### Second semester

<b>A. Major courses*</b>			
<b>S.No</b>	<b>Courses Code</b>	<b>Title of Course</b>	<b>Credit hours</b>
1	Agro 503	Principles and practices of weed management	3(2+1)
2	Agro 504	Principles and practices of water management	3(2+1)
3	Agro 507	Agronomy of oilseeds, fiber and sugar crops	3(2+1)
4	Agro 512	Dry land farming and watershed management	3(2+1)
	Total		12(8+4)
<b>B. Minor courses**</b>			
2	A Soils 509	Soil, water and air pollution	2(1+1)
	Total		2(1+1)
<b>C. Supporting courses***</b>			
1	A.STAT 512	Experimental design	3(2+1)
	Total		3(2+1)
<b>D. Non credit course</b>			
1	PGS 501	Library and information services	N.C.
2	PGS 504	Basic Concepts in Laboratory Techniques	N.C.
	Grand Total		17(11+6)

### Third semester

<b>A. Major courses*</b>			
<b>S.No</b>	<b>Courses Code</b>	<b>Title of Course</b>	<b>Credit hours</b>
1	Agro. 591	Master Seminar	1(0+1)
2	Agro. 599	Master's Research	10(0+10)
	Total		11(1+10)
<b>B. Non Credit Course**</b>			
1	PGS 506	Disaster Management	N.C.
2	PGS 505	Agricultural Research, Research Ethics and Rural Development Programmes	N.C.
	Grand Total		11(1+10)

### Fourth Semester

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

**M. Sc. (Ag) Agronomy**  
**Detail of Courses**  
**SEMESTER FIRST**

**(1) AGRO 501- MODERN CONCEPTS IN CROP PRODUCTION**

**2(2+0)**

**Objective** \_ To teach the basic concepts of soil management and crop production.

**Theory**

UNIT I- Crop growth analysis in relation to environment; agro-ecological zones of India.

UNIT II- Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.

UNIT III- Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

UNIT IV- Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.

UNIT V- Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture.

**Suggested Readings**

- ❖ Balasubramanian P & Palaniappan SP. 2001. Principles and Practices of Agronomy. Agrobios.
- ❖ Reddy SR. 2000. Principles of Crop Production. Kalyani Publ.
- ❖ Sankaran S & Mudaliar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ.
- ❖ Singh SS. 2006. Principles and Practices of Agronomy. Kalyani.

## **(2) AGRO 502- SOIL FERTILITY AND NUTRIENT MANAGEMENT**

**3(2+1)**

**Objective** - To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and Sustainability of soil fertility.

### **Theory**

UNIT I- Soil fertility and productivity-factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

UNIT II - Criteria of essentiality of nutrients; Essential plant nutrients—their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.

UNIT III- Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.

UNIT IV- Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

UNIT V- Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermincompost and residue wastes in crops.

### **Practical**

- ❖ Determination of soil pH, EC, organic C, total N, available N, P, K and S in soils.
- ❖ Determination of total N, P, K and S in plants.
- ❖ Interpretation of interaction effects and computation of economic and yield optima.

### **Suggested Readings**

- ❖ Brady NC & Weil R.R 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.
- ❖ Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.
- ❖ Prasad R & Power JF. 1997. Soil Fertility Management for Sustainable Agriculture. CRC Press.
- ❖ Yawalkar KS, Agrawal JP & Bokde S. 2000. Manures and Fertilizers. Agri-Horti Publ.

**(3) AGRO- 506 AGRONOMY OF MAJOR CEREALS, PULSES AND FODDER 3(2+1)**

**Objective:** To teach the crop husbandry of cereals , pulse and fodder crops.

**Theory:**

UNIT I Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Wheat, barley, oat, rice, maize, sorghum, bajra.

UNIT II Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of chickpea, field pea, lentil, rajmash, arhar, urd, moong, cowpea, soybean .

UNIT III Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like, *guar*, , berseem, *senji*, lucerne etc .

UNIT IV Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasses, napier grass, guinea grass, nandi grass, dinanath grass etc.

UNIT V Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage;

**Practical**

- ❖ Estimation of crop yield on the basis of yield attributes
- ❖ Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- ❖ Working out growth indices (CER, CGR, RGR, NAR, LAD)
- ❖ Planning and layout of field experiments
- ❖ Judging of physiological maturity in different crops
- ❖ Intercultural operations in different crops
- ❖ Determination of cost of cultivation of different crops
- ❖ Working out harvest index of various crops
- ❖ Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- ❖ Visit to nearby villages for identification of constraints in crop production

**Suggested Readings**

- ❖ Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- ❖ Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.
- ❖ Jeswani LM & Baldev B. 1997. *Advances in Pulse Production Technology*. ICAR.
- ❖ Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
- ❖ Singh, SS. 1998. *Crop Management*. Kalyani.



#### **(4)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.

**(5) AGRO 511-CROPPING SYSTEMS AND SUSTAINABLE AGRICULTURE 1(1+0)**

**Objective:** To acquaint the students about prevailing cropping systems in the country and practices to improve their productivity.

**Theory**

UNIT I- Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.

UNIT II- Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.

UNIT III- Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.

UNIT IV- Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system.

UNIT V- Plant ideotypes for drylands; plant growth regulators and their role in sustainability.

**Suggested Readings**

- ❖ Palaniappan SP & Sivaraman K. 1996. Cropping Systems in the Tropics;
- ❖ Panda SC. 2003. Cropping and Farming Systems. Agrobios.
- ❖ Reddy SR. 2000. Principles of Crop Production. Kalyani.
- ❖ Sankaran S & Mudaliar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ. Co.
- ❖ Singh SS. 2006. Principles and Practices of Agronomy. Kalyani.

## **(6) 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, CO<sub>2</sub> reduction in Calvin cycle, Carbon fixation in C<sub>4</sub>,C<sub>3</sub> 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 Associates

**(7) 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.

## **(8)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**

- ❖ English Dictionary. 1995. Harper Collins. Gordon HM & Walter JA. 1970.
- ❖ Technical Writing. 3rd Ed. Holt, Rinehart & Winston. Hornby AS. 2000. Comp.
- ❖ James HS. 1994. Handbook for Technical Writing. NTC
- ❖ Mohan K. 2005. Speaking English Effectively.
- ❖ High School English Grammar and Composition. S. Chand & Co.

## **(9) 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.*

**M. Sc.(Ag) Agronomy**  
**Semester-wise distribution of courses**

**Second Semester**

<b>A. Major courses*</b>			
<b>S.No</b>	<b>Courses Code</b>	<b>Title of Course</b>	<b>Credit hours</b>
1	Agro 503	Principles and practices of weed management	3(2+1)
2	Agro 504	Principles and practices of water management	3(2+1)
3	Agro 507	Agronomy of oilseeds, fiber and sugar crops	3(2+1)
4	Agro 512	Dry land farming and watershed management	3(2+1)
	Total		12(8+4)
<b>B. Minor courses**</b>			
2	A Soils 509	Soil, water and air pollution	2(1+1)
	Total		2(1+1)
<b>C. Supporting courses***</b>			
1	A.STAT 512	Experimental design	3(2+1)
	Total		3(2+1)
<b>D. Non credit course</b>			
1	PGS 501	Library and information services	N.C.
2	PGS 504	Basic Concepts in Laboratory Techniques	N.C.
	Grand Total		17(11+6)

## **AGRON 503 -PRINCIPLES AND PRACTICES OF WEED MANAGEMENT (2+1)**

### **Objective**

To familiarize the students about the weeds, herbicides and methods of weed control.

### **Theory**

UNIT I: Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices.

UNIT II: Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.

UNIT III: Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allelochemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.

UNIT IV: Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control.

UNIT V: Integrated weed management; cost: benefit analysis of weed management.

### **Practical**

- Identification of important weeds of different crops
- Preparation of a weed herbarium
- Weed survey in crops and cropping systems
- Crop-weed competition studies
- Preparation of spray solutions of herbicides for high and low-volume sprayers
- Use of various types of spray pumps and nozzles and calculation of swath width
- Economics of weed control
- Herbicide resistance analysis in plant and soil
- Bioassay of herbicide resistance
- Calculation of herbicidal requirement

### **Suggested Readings**

Aldrich RJ & Kramer RJ. 1997. Principles in Weed Management. Panima Publ.

Ashton FM & Crafts AS. 1981. Mode of Action of Herbicides. 2nd Ed. Wiley Inter-Science.

Gupta OP. 2007. Weed Management – Principles and Practices. Agrobios.

Mandal RC. 1990. Weed, Weedicides and Weed Control - Principles and Practices. Agro-Botanical Publ.

Rao VS. 2000. Principles of Weed Science. Oxford & IBH.

Subramanian S, Ali AM & Kumar RJ. 1997. All About Weed Control. Kalyan i.

Zimdahl RL. 1999. Fundamentals of Weed Science. 2nd Ed. Academic Press.

Kewat, M.L. and Sharma, R.S. (2007). A Practical Manual for Weed Control, College of Agriculture, JNVV, Jabalpur publication



## **AGRON 504-PRINCIPLES AND PRACTICES OF WATER MANAGEMENT (2+1)**

### **Objective**

To teach the principles of water management and practices to enhance the water productivity.

### **Theory**

UNIT I - Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states.

UNIT II- Soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition.

UNIT III- Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; microirrigation system; fertigation; management of water in controlled environments and polyhouses.

UNIT IV- Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency.

UNIT V- Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing.

### **Practical**

- Measurement of soil water potential by using tensiometer, and pressure plate and membrane apparatus
- Soil-moisture characteristics curves
- Water flow measurements using different devices
- Determination of irrigation requirements
- Calculation of irrigation efficiency
- Determination of infiltration rate
- Determination of saturated/unsaturated hydraulic conductivity

### **Suggested Readings**

Lenka D. 1999. Irrigation and Drainage. Kalyani

Michael AM. 1978. Irrigation: Theory and Practice. Vikas Publ.

Paliwal KV. 1972. Irrigation with Saline Water. IARI Monograph, New Delhi.

Panda SC. 2003. Principles and Practices of Water Management. Agrobios.

Prihar SS & Sandhu BS. 1987. Irrigation of Food Crops - Principles and Practices. ICAR.

Reddy SR. 2000. Principles of Crop Production. Kalyani.

Singh Pratap & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ.

## **AGRON 512 -DRYLAND FARMING AND WATERSHED MANAGEMENT**

**(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, tilth, 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.

Katyal 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.

## **SOILS 509 SOIL, WATER AND AIR POLLUTION 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.

UNIT V Toxic elements—their sources, behavior in soils, effect on nutrients availability, effect on plant and human health.

UNIT VI Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases—carbon dioxide, methane and nitrous oxide.

UNIT VIII 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. Katyal 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.

Venkateshwarlu J. 2004. *Rainfed Agriculture in India. Research and Development Scenario*. ICAR.

## **AGRO 507 AGRONOMY OF OILSEED, FIBRE AND SUGAR CROPS 2+1**

### **Objective:-**

To teach the crop husbandry of oilseed, fiber and sugar crops. Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for production of :-

#### **UNIT I**

*Rabi* oilseeds – Rapeseed and mustard, linseed, etc.

#### **UNIT II**

*Kharif* oilseeds - Groundnut, sesame, castor, sunflower, soybean etc.

#### **UNIT III**

Fiber crops - Cotton, jute, sunhemp etc.

#### **UNIT IV**

Sugar crops – Sugar-beet and sugarcane.

### **PRACTICAL**

- Planning and layout of field experiments
- Cutting of sugarcane sets, its treatment and methods of sowing, tying and propping of sugarcane
- Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop
- Intercultural operations in different crops
- Cotton seed treatment
- Working out growth indices (LER, CGR, RGR, NAR, LAD) aggressively, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems
- Judging of physiological maturity in different crops and working out harvest index
- Working out cost of cultivation of different crops
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Determination of oil content in oilseeds and computation of oil yield
- Estimation of quality of fiber of different fiber crops
- Study of seed production techniques in various crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

### **Suggested Readings**

- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Das PC. 1997. *Oilseed Crops of India*. Kalyani.
- Lakshmikantam N. 1983. *Technology in Sugarcane Growing*. 2 Ed. Oxford & IBH.
- Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
- Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
- Singh SS. 1998. *Crop Management*. Kalyani.

**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 vaccumets; 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.

**STAT 512****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](http://www.iasri.res.in/design).

## **PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES**

### **Objective**

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

### **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 programmes: 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 programmes. Constraints in implementation of rural policies and programmes.

### **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.