

# **FACULTY OF AGRICULTURAL SCIENCES**

## **Syllabus**

M.Sc. Ag. (Agronomy)  
**(2020-21)**



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

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## 1. Executive Summary

The role of agronomy is significant in agro eco-system. Understanding the growth, development, mechanisms of photosynthesis, photorespiration, nitrogen fixation and other metabolic pathways, behaviour of enzymes, development of fermentation technologies and modern biology tools have changed the trend in agronomical research. The advancement made in last few decades in agronomy is now reflected in teaching and research in allied agricultural sciences. There has been more use of modern techniques in crop production, mineral nutrition, chemical analysis of soil, plant and various agricultural products. Courses on cereals, pulses, oilseeds, weed management, climatology, fertilizer management, organic farming, irrigation management, water shed management and crop modeling has become necessary for improving the quality of education leading to post graduates passing out with applied knowledge including skill and entrepreneurship. Haryana is primarily an agricultural state with 70% of population pre-dominantly engaged in agriculture. Haryana is self-sufficient in food production and the second largest contributor to India's central pool of food grains with the scope of education to sustain productivity and soil fertility. The main crops of Haryana are wheat, rice, sugarcane, cotton, oilseeds, gram, barley, corn and millet etc.

The existing M.Sc. **Ag. (Agronomy)** programme running at national level is inadequate to meet the present and envisaged human resource requirement. The programme needs to be expanded as done in the Syllabus of Agronomy in Agricultural Scientists Recruitment Board (ASRB) Examinations. The envisaged M. Sc. programmes are:

### 1.1. Organization of Course Contents & Credit Requirements

#### 1.1.1. General Information about Course Code Numbers

- i). All courses for M.Sc. Ag. (Agronomy) are of 500-series.
- ii). Credit seminar has been designated by code no. 591, while code no. 599 pertains for Master's Research.

#### 1.1.2. General Information about Course Contents

The contents of each course have been organized into:

- i). Objective (s) – to elucidate the basic purpose.
- ii). Theory units – to facilitate uniform coverage of syllabus for paper setting.
- iii). Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.

#### 1.1.3. Minimum Credit Requirement

Subject*	Master's Programme
Major	20
Minor	09
Supporting	05
Seminar	01
Research	20

Total Credits	55
Compulsory Non Credit Courses	Section 5

\*Major subject: The subject (discipline) in which the students takes admission.

Minor subject: The subject closely related to major subject.

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

Non-Credit Compulsory Courses: Please see Section 5 for details. Six courses are of general nature and are compulsory for Master's programme.

## 2. MAJOR SUBJECT

### 2.1. Courses' Structure at a Glance

Course Code (ICAR pattern)	Course Code (SGTU pattern)	Course Title	Credits
AGRON 501*	11060108	MODERN CONCEPTS IN CROP PRODUCTION	3(3+0)
AGRON 502*	11060207	PRINCIPLES AND PRACTICES OF SOIL FERTILITY AND NUTRIENT MANAGEMENT	3(2+1)
AGRON 503*	11060209	PRINCIPLES AND PRACTICES OF WEED MANAGEMENT	3(2+1)
AGRON 504*	11060210	PRINCIPLES AND PRACTICES OF WATER MANAGEMENT	3(2+1)
AGRON 505	11060109	AGROMETEOROLOGY AND CROP WEATHER FORECASTING	3(2+1)
AGRON 506	11060110	AGRONOMY OF MAJOR CEREALS AND PULSES	3(2+1)
AGRON 511	11060211	CROPPING SYSTEM	2(2+0)
AGRON 591	11060405	MASTER'S SEMINAR	1(1+0)
AGRON 599	11060406	MASTER'S RESEARCH	

\*Compulsory Course

# Course numbers are as per ICAR recommendation and guidelines.

#### 2.1.1 Course Content

##### 11060108: MODERN CONCEPTS IN CROP PRODUCTION 3(3+0)

###### Objective

To teach the basic concepts of soil management and crop production.

###### Theory

###### UNIT-I

Crop growth analysis in relation to environment; geo-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**

- Balasubramaniyan P & Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.
- Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
- Paroda R.S. 2003. *Sustaining our Food Security*. Konark Publ.
- Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.
- Sankaran S & Mudaliar TV. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.
- Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

### **11060207: PRINCIPLES AND PRACTICES OF 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.
- Fageria NK, Baligar VC & Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops*. Marcel Dekker.
- 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.

### 11060209: PRINCIPLES AND PRACTICES OF WEED MANAGEMENT 3(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*. Kalyani.
- Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic Press.

## **11060210: PRINCIPLES AND PRACTICES OF WATER MANAGEMENT 3(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.

## **11060109: AGROMETEOROLOGY AND CROP WEATHER FORECASTING 3(2+1)**

### **Objective**

To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions.

### **Theory**

#### **UNIT-I**

Agro meteorology - aim, scope and development in relation to crop environment; composition of atmosphere, distribution of atmospheric pressure and wind.

#### **UNIT-II**

Characteristics of solar radiation; energy balance of atmosphere system; radiation distribution in plant canopies, radiation utilization by field crops; photosynthesis and efficiency of radiation utilization by field crops; energy budget of plant canopies; environmental temperature: soil, air and canopy temperature.

#### **UNIT-III**

Temperature profile in air, soil, crop canopies; soil and air temperature effects on plant processes; environmental moisture and evaporation: measures of atmospheric temperature and relative humidity vapor pressure and their relationships; evapo-transpiration and meteorological factors determining evapotranspiration.

#### **UNIT-IV**

Modification of plant environment: artificial rain making, heat transfer, controlling heat load, heat trapping and shading; protection from cold, sensible and latent heat flux, controlling soil moisture; monsoon and their origin, characteristics of monsoon; onset, progress and withdrawal of monsoon; weather hazards, drought monitoring and planning for mitigation.

#### **UNIT-V**



Weather forecasting in India – short, medium and long range; aerospace science and weather forecasting; benefits of weather services to agriculture, remote sensing; application in agriculture and its present status in India; atmospheric pollution and its effect on climate and crop production; climate change and its impact on agriculture.

### **Practical**

- Visit to agro-meteorological observatory and to record sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature, evaporation, precipitation and atmospheric pressure
- Measurement of solar radiation outside and within plant canopy
- Measurement/estimation of evapo-transpiration by various methods
- Measurement/estimation of soil water balance
- Rainfall variability analysis
- Determination of heat-unit requirement for different crops
- Measurement of crop canopy temperature
- Measurement of soil temperatures at different depths
- Remote sensing and familiarization with agro-advisory service bulletins
- Study of synoptic charts and weather reports, working principle of automatic weather station
- Visit to solar observatory

### **Suggested Readings**

- Chang Jan Hu 1968. *Climate and Agriculture on Ecological Survey*. Aldine Publ.
- Critchfield HJ.1995. *General Climatology*. Prentice Hall of India.
- Das PK.1968. *The Monsoons*. National Book Trust Publ.
- Lal DS.1998. *Climatology*. Sharda Pustak Bhawan.
- Lenka D.1998. *Climate, Weather and Crops in India*. Kalyani.
- Mavi H.S.1994. *Introduction to Agro-meteorology*. Oxford & IBH.
- Mavi HS & Tupper GJ. 2004. *Agrometeorology: Principles and Application of Climate Studies in Agriculture*. Haworth Press.
- Menon PA.1991. *Our Weather*. National Book Trust Publ.
- Sahu DD. *Agrometeorology and Remote Sensing: Principles and Practices*. Agrobios.
- Variraju R & Krishnamurty 1995. *Practical Manual on Agricultural Meteorology*. Kalyani.
- Varshneya MC & Balakrishana Pillai P. 2003. *Textbook of Agricultural Meteorology*. ICAR.

## **11060110: AGRONOMY OF MAJOR CEREALS AND PULSES 3(2+1)**

### **Objective**

To teach students, the crop husbandry of cereals and pulse crops.

### **Theory**

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:

#### **UNIT-I**

*Rabi* cereals.

#### **UNIT-II**

*Kharif* cereals.

#### **UNIT-III**

Rabi pulses.

#### UNIT-IV

Kharif pulses.

#### Practical

- Phenological studies at different growth stages of crop
- 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), aggressiveness, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems of different crops
- Estimation of protein content in pulses
- 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
- 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.
- Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.
- Jeswani LM & Baldev B. 1997. *Advances in Pulse Production Technology*. ICAR.
- Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.
- Kumar Ranjeet & Singh NP. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
- Pal M, Deka J & Rai RK. 1996. *Fundamentals of Cereal Crop Production*. Tata McGraw Hill.
- 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.
- Yadav DS. 1992. *Pulse Crops*. Kalyani.

### 11060211: CROPPING SYSTEM 2(2+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; Principles and Management*. New Age.
- 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.
- Tisdale SL, Nelson WL, Beaton JD & Havlin JL. 1997. *Soil Fertility and Fertilizers*. Prentice Hall.

### 3. MINOR SUBJECT (Soil Science)

#### 3.1. Courses' Structure at a Glance

Course Code (ICAR pattern)	Course Code (SGTU pattern)	Course Title	Credits
SOILS 505	11060403	SOIL EROSION AND CONSERVATION	3(2+1)
SOILS 511	11060105	ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS	2(0+2)
SOILS 513	11060112	MANAGEMENT OF PROBLEMATIC SOILS AND WATERS	3(2+1)
SOILS 514	11060402	FERTILIZER TECHNOLOGY	1(1+0)

#### 3.1.1. Course Content

##### 11060403: SOIL EROSION AND CONSERVATION 3(2+1)

#### Objective

To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water.

## **Theory**

### **UNIT-I**

History, distribution, identification and description of soil erosion problems in India.

### **UNIT-II**

Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity - estimation as EI30 index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation.

### **UNIT-III**

Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.

### **UNIT-IV**

Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout.

### **UNIT-V**

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

### **UNIT-VI**

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds.

## **Practical**

- Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index
- Computation of kinetic energy of falling rain drops
- Computation of rainfall erosivity index (EI30) using rain gauge data
- Visits to a watersheds

## **Suggested Readings**

- Biswas TD & Narayanasamy G. (Eds.) 1996. *Soil Management in Relation to Land Degradation and Environment*. Bull. Indian Society of Soil Science No. 17.
- Doran JW & Jones AJ. 1996. *Methods of Assessing Soil Quality*. Soil Science Society of America, Spl Publ. No. 49, Madison, USA.
- Gurmali Singh, Venkataramanan C, Sastry G & Joshi BP. 1990. *Manual of Soil and Water Conservation Practices*. Oxford & IBH.
- Hudson N. 1995. *Soil Conservation*. Iowa State Univ. Press. Indian Society of Soil Science 2002. *Fundamentals of Soil Science*. ISSS, New Delhi.
- Oswal MC. 1994. *Soil Physics*. Oxford & IBH.

## **11060105: ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS 2(0+2)**

### **Objective**

To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples.

### **Practical**

#### **UNIT-I**

Preparation of solutions for standard curves, analytical reagents, qualitative reagents, indicators and standard solutions for acid-base, oxidation reduction and complexometric titration; soil, water and plant sampling techniques, their processing and handling.

#### **UNIT-II**

Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.

#### **UNIT-III**

Principles of visible, ultraviolet and infrared spectrophotometry, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques, mass spectrometry and X-ray diffractometry; identification of minerals by X-ray by different methods.

#### **UNIT-IV**

Electrochemical titration of clays; determination of cation and anion exchange capacities of soils; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity.

#### **UNIT-V**

Analysis of soil and plant samples for N, P, K, Ca, Mg, S, Zn, Cu, Fe, Mn, B and Mo; analysis of plant materials by digesting plant materials by wet and dry ashing and soil by wet digestion methods.

#### **UNIT-VI**

Determination of lime and gypsum requirement of soil; drawing normalized exchange isotherms; measurement of redox potential.

#### **UNIT-VII**

Analysis of soil extracts and irrigation waters for their soluble cations and anions and interpretation of results.

### **Suggested Readings**

- Hesse P. 1971. *Textbook of Soil Chemical Analysis*. William Clowes & Sons.
- Jackson ML. 1967. *Soil Chemical Analysis*. Prentice Hall of India.
- Keith A Smith 1991. *Soil Analysis; Modern Instrumental Techniques*. Marcel Dekker.
- Kenneth Helrich 1990. *Official Methods of Analysis*. Association of Official Analytical Chemists.
- Page AL, Miller RH & Keeney DR. 1982. *Methods of Soil Analysis*. Part II. SSSA, Madison.
- Piper CE. *Soil and Plant Analysis*. Hans Publ.
- Singh D, Chhonkar PK & Pandey RN. 1999. *Soil Plant Water Analysis - A Methods Manual*. IARI, New Delhi.
- Tan KH. 2003. *Soil Sampling, Preparation and Analysis*. CRC Press/Taylor & Francis.
- Tandon HLS. 1993. *Methods of Analysis of Soils, Fertilizers and Waters*. FDCO, New Delhi.
- Vogel AL. 1979. *A Textbook of Quantitative Inorganic Analysis*. ELBS Longman.

## **11060112: MANAGEMENT OF PROBLEMATIC SOILS AND WATERS 3(2+1)**

### **Objective**

To educate students about basic concepts of problem soils and brackish water, and their management. Attention will be on management of problem soils and safe use of brackish water in relation to crop production.

### **Theory**

#### **UNIT-I**

Area and distribution of problem soils – acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, and factors responsible.

#### **UNIT-II**

Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils - soluble salts, ESP, pH; physical, chemical and microbiological properties.

#### **UNIT-III**

Management of salt-affected soils; salt tolerance of crops - mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils.

#### **UNIT-IV**

Acid soils - nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

#### **UNIT-V**

Quality of irrigation water; management of brackish water for irrigation; salt balance under irrigation; characterization of brackish waters, area and extent; relationship in water use and quality.

#### **UNIT-VI**

Agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters.

### **Practical**

- Characterization of acid, acid sulfate, salt-affected and calcareous soils
- Determination of cations (Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>++</sup> and Mg<sup>++</sup>) in ground water and soil samples
- Determination of anions (Cl<sup>-</sup>, SO<sub>4</sub><sup>--</sup>, CO<sub>3</sub><sup>--</sup> and HCO<sub>3</sub><sup>-</sup>) in ground waters and soil samples
- Lime and gypsum requirements of acid and sodic soils

### **Suggested Readings**

- Bear FE. 1964. *Chemistry of the Soil*. Oxford & IBH.
- Jurinak JJ. 1978. *Salt-affected Soils*. Department of Soil Science & Biometeorology. Utah State Univ.
- USDA Handbook No. 60. 1954. *Diagnosis and improvement of Saline and Alkali Soils*. Oxford & IBH.

## **11060402: 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, super-granules 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.

## 4. BASIC SUPPORTING COURSES

### 4.1. Courses' structure at a Glance

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)

#### 4.1.1. Course Content

#### 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.

### 5. COMPULSORY NON-CREDIT COURSES

#### 5.1. Courses' Structure at a Glance

Course Code (ICAR pattern)	Course Code (SGTU pattern)	Course Title	Credits
PGS 501	11060111	LIBRARY AND INFORMATION SERVICES	1(0+1)
PGS 502	11060204	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	1(0+1)
PGS 503	11060205	INTELLECTUAL PROPERTY & ITS MANAGEMENT IN AGRICULTURE (e-Course)	1(1+0)
PGS 504	11060206	BASIC CONCEPTS IN LABORATORY TECHNIQUES	1(0+1)
PGS 505	11060306	AGRICULTURAL RESEARCH, RESEARCH ETHICS & RURAL DEVELOPMENT PROGRAMMES (e-Course)	1(1+0)
PGS 506	11060106	DISASTER MANAGEMENT (e-Course)	1(1+0)

#### 5.1.1 Course Content

## **11060111: 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; e-resources access methods.

## **11060204: 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**

- Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek, Chandigarh. Chicago Manual of Style. 14th Ed. 1996. Prentice-Hall of India, New Delhi.
- Collins' Cobuild English Dictionary. 1995. Harper Collins, New York.
- Gibaldi, Joseph. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press, New Delhi.
- Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford UP, Oxford.
- Krishna Mohan 2005. Speaking English Effectively. Macmillan India, New Delhi.
- Mills Gordon H & John A Walter. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston, New York.

- Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice-Hallof India, New Delhi.
- Shelton James H. 1994. Handbook for Technical Writing. NTC Business Books, Chicago. Smith Richard W. 1969. Technical Writing. Barnes & Noble, New York.
- Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand, New Delhi.

## **11060205: INTELLECTUAL PROPERTY & ITS MANAGEMENT IN AGRICULTURE (e-Course) 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 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 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, Wallingford.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw- Hill, New Delhi. India,
- Intellectual Property Rights: Key to New Wealth Generation.2001. NRDC and Aesthetic Technologies, New Delhi.
- Ministry of Agriculture. GoI., 2004. State of Indian Farmer. Vol. 5. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild, Max & Newman, Scott (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, Delhi.
- The Indian Acts - Patents Act, 1970 & amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 & amendments; Layout Design Act, 2000; PPV & FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

## **11060206: 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 agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation 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, sandbath, waterbath, oilbath; 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.

## **11060306: AGRICULTURAL RESEARCH, RESEARCH ETHICS & RURAL DEVELOPMENT PROGRAMMES (e-Course) 1(1+0)**

### **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.

### **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 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.

## **11060106: DISASTER MANAGEMENT (E-Course) 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.