



**Kamla Nehru Institute of Physical &  
Social Sciences, Sultanpur (UP)-228118**  
(An Autonomous Institute)

'NAAC - 'A' Grade'


Structure of syllabus for the program


B.Sc. (AG) & M.Sc. (AG): Subject- Agronomy


Syllabus developed/proposed by

S.No.	Name	Designation	Department	College/University/Address
1.	Dr. Rajesh Dutt Singh	Convenor	Agronomy	K.N.I.P.S.S., Sultanpur
2.	Dr. Abhinav Kumar Singh	Member	Agronomy	K.N.I.P.S.S., Sultanpur
3.	Dr. Sushil Kumar Srivastava	Member	Agronomy	K.N.I.P.S.S., Sultanpur
4.	Dr. Ankit Singh	Member	Agronomy	K.N.I.P.S.S., Sultanpur
5.	Prof. Shiv Prakash Singh	Member (Nominee Academic Council)	Agronomy	B.H.U. Varanasi
6.	Prof. A.K. Singh	Member (Nominee Academic Council)	Agronomy	A.N.D.A.U.T., Kumarganj, Ayodhya
7.	Dr. Gajendra Singh	Member (Nominee V.C., Dr. RMLAU)	Agronomy	A.N.D.A.U.T., Kumarganj, Ayodhya
8.	Sri Baldev Singh (Industrialist)	Member (Nominated Principal)	NA	Punjabi Colony, Kurwara Naka, Sultanpur
9.	Sri Jagjeet Singh (Ex-student)	Member (Nominated Principal)	NA	Near Vijay Delux, Laldiggi, Sultanpur


As per syllabus development guidelines of Higher Education for UG & PG Course-

  
(Dr. Abhinav Kumar Singh)  
Member  
K.N.I.P.S.S., Sultanpur


  
(Dr. Ankit Singh)  
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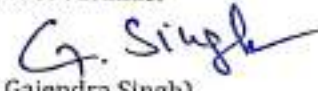
  
(Prof. A.K. Singh)  
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UNDER GRADUATE CURRICULAR & SYLLABUS  
B.Sc. (Hons.) Agriculture  
Semester System as per ICAR V<sup>th</sup> Deans Committee Report  
DEPARTMENT OF AGRONOMY

Course Code	Course Title	Credit Hours
AG-101	Fundamentals of Agronomy	3(2+1)
AG-109	Agricultural Heritage	1(1+0)
AG-205	Principles of Organic Farming	2(1+1)
AG-301	Crop Production Technology-I (Kharif Crops)	2(1+1)
AG-302	Practical Crop Production-I (Kharif Crops)	2(0+2)
AG-401	Crop Production Technology-II (Rabi Crops)	2(1+1)
AG-402	Practical Crop Production-II (Rabi Crops)	2(0+2)
AG-409	Introductory Agro-meteorology & Climate Change	2(1+1)
AG-501	Rainfed and Dryland Agriculture	2(1+1)
AG-601	Farming System, Precision Farming Sustainable Agriculture	2(1+1)
AG-607	Watershed and Wasteland Management	2(1+1)
AGE-63	Weed Management	3(2+1)







# AGRONOMY

## 1. Fundamentals of Agronomy

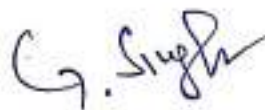
3(2+1) AG-101

### Theory

Agronomy and its scope. seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant- water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water. Weeds- importance. classification, crop weed competition, concepts of weed management- principles and methods, herbicides- classification, selectivity and resistance, allelopathy, Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, harvesting and threshing of crops.

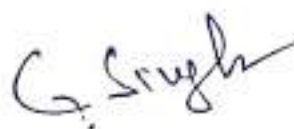
### Practical

Identification of crops, seeds, fertilizers, pesticides and tillage implements. Identification of weeds in crops, Methods of herbicide and fertilizer application. Study of yield contributing characters and yield estimation. Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Study of soil moisture measuring devices, Measurement of irrigation water.



## Theory

Introduction of Indian agricultural heritage; Ancient agricultural practices. Relevance of heritage to present day agriculture; Past and present status of agriculture and farmers in society; Journey of Indian agriculture and its development from past to modern era; Plant production and protection through indigenous traditional knowledge; Crop voyage in India and world; Agriculture scope; Importance of agriculture and agricultural resources available in India; Crop significance and classifications; National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

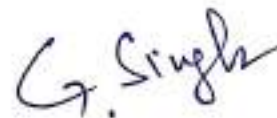


**Theory**

Origin geographical distribution, economic importance. soil and climatic requirements. varieties, cultural practices and yield of Kharif crops, Cereals - rice, maize, sorghum, pearl millet and finger millet, pulses-pigeonpea, mungbean and urdbean; oilseeds- til, groundnut. and soybean; fibre crops- cotton & jute; forage crops-sorghum. cowpea, cluster bean and napier.

**Practical**

Rice nursery preparation. transplanting of rice, sowing of soybean, pigeonpea and mungbean. Maize, groundnut and cotton, effect of seed size on germination. Effect of sowing depth on germination of kharif crops, identification of weeds in kharif season crops. top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of kharif season crops, study of crop varieties and important agronomic experiments at experimental farm. Visit to research centres related to crops.



**Theory**

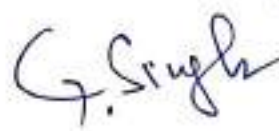
Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rabi crops; cereals -wheat, barley and oat, pulses-chickpea, lentil, peas, oilseeds-rapeseed, mustard, linseed and sunflower; sugar crops-sugarcane; other crop-Potato. Forage crops-berseem, lucerne and oat.

**Practical**

Sowing methods of wheat and sugarcane, identification of weeds in rabi season crops, Numerical problems on seed requirement of rabi crop, Study of yield contributing characters of rabi season crops, study of important agronomic experiments of rabi crops at experimental farms. Study of rabi forage experiments, visit to research stations of related crops.



## I. Introductory Agro-meteorology & Climate Change 2(1+1) AG-409

### Theory

Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature; Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking, Monsoon-mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

### Practical

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and longwave radiation, and its estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of Radiation Intensity using ASS. Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of windrose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.




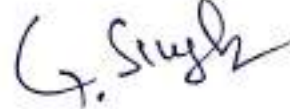
## 5. Farming System, Precision Fanning and Sustainable Agriculture 2(1+1) AG-601

### Theory

Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Sustainable agriculture-problems and its impact on agriculture, conservation agriculture strategies, HEIA, LELA and LEISA and its techniques for sustainability, Integrated farming system components of IFS and its advantages, farming system and environment.

### Practical

- Tools for determining productions & efficiencies in cropping and farming systems.
- Indicators of sustainability of cropping & Fanning systems
- Site specific development of IFS models for different agro-climatic zones.
- Visit of IFS models in different agro climatic zones of nearby state Universities/Institutes and farmer fields.



Practical

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.

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**Practical**

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students.


**Theory**

Organic farming, principles and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture. Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production; Certification process and standards Of organic farming.

**Practical**

Visit of organic farms to study the various components and their utilization: Preparation of enrich compost, vermicompost, Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Quality aspect, grading, packaging and handling.




**Theory**

Rainfed and dryland agriculture-Introduction, types and history. Problems & prospects of rainfed agriculture in India. Soil and climatic conditions prevalent in rainfed areas. Drought: types, effect of water deficit on physio-morphological characteristics of the plants. Mechanism of crop adoption under moisture deficit conditions. Efficient utilization of water through soil and crop management practices, management of crops in rainfed areas. Contingent crop planning for aberrant weather conditions. Precision agriculture; concepts and techniques: their issues and concerns for Indian agriculture.

**Practical**

Studies on climatic classifications, studies on rainfall pattern in rainfed areas of the country. Studies on cropping pattern of different dryland areas in the country and demarcation of dryland area on map of India. Interpretation of metrological data and scheduling of supplemental irrigations on the basis of evapo-transpiration demand of crops effective rainfall and its calculations. Visit to rainfed research stations/watersheds.

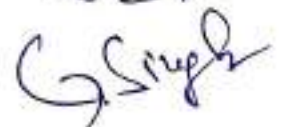
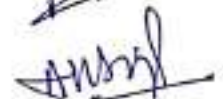
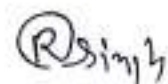


**Theory**

Watershed management - Concept need, principles & components of watershed management integrated watershed management. Factors effecting watershed management runoff & soil loss management in a watershed socio-economic concept of watershed. Peoples participation in watershed management. Policy approaches & management plan, problems of watershed management. Wasteland management - Definition, concept & types of degraded & wasteland. Distribution & extent of watershed in India & Uttar Pradesh. factors responsible for land degradation, characteristics of different types of degradation & wasteland. Problems of degraded land in Uttar Pradesh. Appropriate techniques for management of different types of degraded & wasteland.

**Practical**

Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.



**Theory**

Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds. Herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use. Introduction to mode of action of herbicides and selectivity. Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture. Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application. Integration of herbicides with non chemical methods of weed management. Herbicide Resistance and its management.

**Practical**

Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds. Study of herbicide formulations and mixture of herbicide. Herbicide and agro-chemicals study. Shift of weed flora study in long term experiments. Study of methods of herbicide application, spraying equipments. Calculations of herbicide doses and weed control efficiency and weed index.

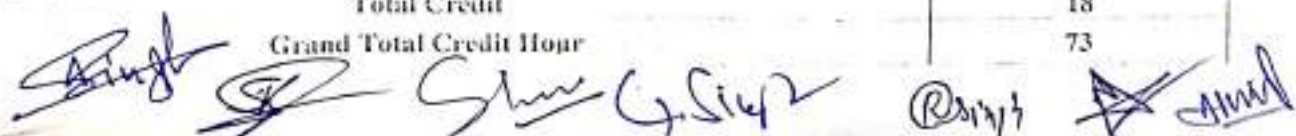

**POST GRADUATE CURRICULAR & SYLLABUS**  
**M.Sc. Ag. Agronomy With Thesis**

M.Sc. Ag. 1 <sup>st</sup> Sem.		
Code No.	Course Title	Credit Hours
*AGRON-501	Modern Concept in Crop Production	3(2+1)
*AGRON-503	Principles & Practices of Weed Management	3(2+1)
*AGRON-505	Conservation Agriculture	2(1+1)
*AGRON-506	Agronomy of Scientific Cultivation of Major Cereals & Pulses	2(1+1)
SS-509	Analytical-technique and instrumental methods in soil and plant analysis	2(0+2)
STAT-502	Statistical Method for Applied Science	4(3+1)
PGS-502	Technical Writing & Communication Skills	1(0+1)
PGS-501	Library and Information Services	1(0+1)
<b>Total Credit</b>		<b>18</b>
M.Sc. Ag. 2 <sup>nd</sup> Sem.		
*AGRON-502	Principles & Practices of Soil Fertility & Nutrients Management	3(2+1)
*AGRON-504	Principles & Practices of Water Management	3(2+1)
*AGRON-507	Agronomy of Scientific Cultivation of Oil Trees Fiber & Sugar Crop	3(2+1)
STAT-511	Experimental Designs	3(2+1)
PGS-504	Basic Concept in Laboratory Techniques	1(0+1)
PGS-503	Intellectual Property & Its Management in Agriculture	1(1+0)
AGRON-560	Research Work	4(0+4)
<b>Total Credit</b>		<b>18</b>
M.Sc. Ag. 3 <sup>rd</sup> Sem.		
*AGRON-509	Agronomy of Fodder & Forage Crops	3(2+1)
SS-507	Soil Water and Air Pollution	3(2+1)
SS-505	Soil Erosion & Conservation	3(2+1)
AGRON-560	Research Work	08(0+8)
PGS-505	Agricultural Research, Research Ethics & Rural Development Programme	1(1+0)
<b>Total Credit</b>		<b>18</b>
M.Sc. Ag. 4 <sup>th</sup> Sem.		
AGRON-550	Master Seminar	01(0+1)
AGRON-560	Master Research (Thesis)	18
<b>Total Credit</b>		<b>19</b>
<b>Grand Total Credit Hour</b>		<b>73</b>

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**POST GRADUATE CURRICULAR & SYLLABUS**  
**M.Sc. Ag. Agronomy without Thesis**

M.Sc. Ag. 1 <sup>st</sup> Sem.		
Code No.	Course Title	Credit Hours
*AGRON-501	Modern Concept in Crop Production	3 (2+1)
*AGRON-503	Principles & Practices of Weed Management	3 (2+1)
*AGRON-505	Conservation Agriculture	2 (1+1)
*AGRON-506	Agronomy Of Scientific Cultivation of Major Cereals & Pulses	2 (1+1)
SS-509	Analytical technique and instrumental methods in soil and plant analysis	2 (0+2)
STAT-502	Statistical Method for Applied Science	4 (3+1)
PGS-502	Technical Writing & Communication Skills	1 (0+1)
PGS-501	Library and Information Services	1 (0+1)
<b>Total Credit</b>		<b>18</b>
M.Sc. Ag. 2 <sup>nd</sup> Sem.		
*AGRON-502	Principles & Practices of Soil Fertility & Nutrients Management	3 (2+1)
*AGRON-504	Principles & Practices of Water Management	3 (2+1)
*AGRON-507	Agronomy of Scientific Cultivation of Oil Trees Fiber & Sugar Crop	3 (2+1)
STAT-511	Experimental Designs	3 (2+1)
PGS-504	Basic Concept in Laboratory Techniques	1 (0+1)
PGS-503	Intellectual Property & Its Management in Agriculture	1 (1+0)
AGRON-551	Project/Dissertation	05 (0+05)
<b>Total Credit</b>		<b>19</b>
M.Sc. Ag. 3 <sup>rd</sup> Sem.		
*AGRON-509	Agronomy of Fodder & Forage Crops	3 (2+1)
SS-507	Soil Water and Air Pollution	3 (2+1)
SS-505	Soil Erosion & Conservation	3 (2+1)
AGRON-510	Agrostology & Agro-Forestry	4 (3+1)
AGRON-512	Dry land Farming & Watershed management	4 (3+1)
PGS-505	Agricultural Research, Research Ethics & Rural Development Programme	1 (1+0)
<b>Total Credit</b>		<b>18</b>
M.Sc. Ag. 4 <sup>th</sup> Sem.		
AGRON-508	Agronomy of medicinal, Aromatic & Utilized Crop	4 (3+1)
AGRON-511	Cropping System & Sustainable Agriculture	4 (3+1)
AGRON-513	Principles & Practice of Organic Farming	4 (3+1)
AGRON-550	Master Seminar	1 (0+1)
AGRON-551	Project/Dissertation	05 (0+05)
<b>Total Credit</b>		<b>18</b>
<b>Grand Total Credit Hour</b>		<b>73</b>





**Course Title with Credit Load**  
**M.Sc. in Agronomy**  
**(Major Courses)**

Course Code	Course Title	Credit Hours
AGRON 501*	Modern Concepts in Crop Production	3 (2+1)
AGRON 502*	Principles and practices of soil fertility and 2+1 nutrient management	3 (2+1)
AGRON 503*	Principles and Practices of Weed Management	3 (2+1)
AGRON 504*	Principles and Practices of Water Management	3 (2+1)
AGRON 505	Conservation Agriculture	2 (1+1)
AGRON 506	Agronomy of major Cereals and Pulses	2 (1+1)
AGRON 507	Agronomy of oilseed, fibre and sugar crops	3 (2+1)
AGRON 508	Agronomy of medicinal, aromatic & underutilized crops	3 (2+1)
AGRON 509	Agronomy of fodder and forage crops	3 (2+1)
AGRON 510	Agrostology and Agro-Forestry	3 (2+1)
AGRON 511	Cropping System and Sustainable Agriculture	2 (2+0)
AGRON 512	Dryland Farming and Watershed Management	3 (2+1)
AGRON 513	Principles and practices of organic farming	3 (2+1)
AGRON 550	Master's Seminar	(1+0)
AGRON 560	Master's research	-30
AGRON-551	Project/Dissertation	05 (0+05)

\*Indicates core course which is Compulsory course for M Sc.(Agri)


**I. Course Title : Modern Concepts in Crop Production**

**II. Course Code : Agron 501**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

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

**V. 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, use of growth hormones and regulators for better adaptation in stressed condition.

**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. Modern crop production concepts: soil less cultivation, Aeroponic, Hydroponic, Robotic and terrace farming, use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture.

**Practical**

- Study of growth analysis, phases of growth yield analysis
- Study of agro-climatic zones of India.
- Study of tillage, modern concept of tillage and related with course.

**VI. Teaching methods/activities**

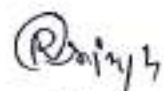
Classroom teaching with AV aids, group discussion, assignment and class discussion

**VII. Learning outcome**

Basic knowledge on soil management and crop production

**VIII. Suggested Reading**

- Balasubramanian P and Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.
- Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7<sup>th</sup> Ed. Prentice Hall.
- Paroda R.S. 2003. *Sustaining our Food Security*. Konark Publ.
- Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.
- Sankaran S and Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.
- Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.
- Alvin PT and kozlowski TT (ed.). 1976. *Ecophysiology of Tropical Crops*. Academia Pul., New York.
- Gardner PP, Pearce GR and Mitchell RL. 1985. *Physiology of Crop Plants*. Scientific Pub. Jodhpur.
- Lal R. 1989. *Conservation tillage for sustainable agriculture: Tropics versus Temperate Environments*. *Advances in Agronomy* 42: 85-197.
- Wilsie CP. 1961. *Crop Adaptation and Distribution*. Euresia Pub., New Delhi.



**I. Course Title : Principal and Practices of Soil Fertility and Nutrient Management**

**II. Course Code : Agron 502**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

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.

**V. 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. Soil less cultivation.

**Unit IV**

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency; agronomic, chemical and physiological, fertilizer mixtures and grades; 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 nutrients; economics of fertilizer use; integrated nutrient management; use of vermincompost and residue wastes in crops.

**VI. Practical**

- Determination of soil pH and soil EC
- Determination of soil organic C
- Determination of available N, P, K and S of soil
- Determination of total N, P, K and S of soil
- Determination of total N, P, K, S in plant
- Computation of optimum and economic yield

**VII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, assignment and class discussion

**VIII. Learning outcome**

Basic knowledge on soil fertility and management

**IX. Suggested Reading**

- Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
- Fageria NK, Baligar VC and Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops*. Marcel Dekker.
- Havlin JL, Beaton JD, Tisdale SL and Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7<sup>th</sup> Ed. Prentice Hall.
- Prasad R and Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
- Yawalkar KS, Agrawal JP and Bokde S. 2000. *Manures and Fertilizers*. Agri-Horti Publ.

**I. Course Title : Principles and Practices of Weed Management**

**II. Course Code : Agron 503**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

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

**V. Theory**

Weed biology, and ecology and classification, crop-weed competition including allelopathy; principles and methods of weed control and classification management; weed indices, weed shift in different ecosystems

**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, sequential application of herbicides, rotation; weed control through use of nano-herbicides and bio-herbicides, myco-herbicides bio-agents, and allelochemicals; movement of herbicides in soil and plant, Degradation of herbicides in soil and plants; herbicide resistance, residue, persistence and management; development of herbicide resistance in weeds and crops and their management, herbicide combination and rotation.

**Unit IV**

Weed management in major crops and cropping systems; alien, invasive and parasitic weeds and their management; weed shifts in cropping systems; aquatic and perennial weed control; weed control in non-crop area.

**Unit V**

Integrated weed management; recent development in weed management- robotics, use of drones and aeroplanes, organic etc., cost: benefit analysis of weed management.

**VI. Practical**

- Identification of important weeds of different crops, Preparation of a weed herbarium, Weed survey in crops and cropping systems, Crop-weed competition studies, Weed indices calculation and interpretation with data, 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 residues,
- Calculation of herbicidal herbicide requirement

**VII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, field visit to identify weeds.

**VIII. Learning outcome**

Basic knowledge on weed identification and control for crop production

**IX. Suggested Reading**

- Böger, Peter, Wakabayashi, Ko, Hirai, Kenji (Eds.). 2002. *Herbicide Classes in Development. Mode of Action, Targets, Genetic Engineering, Chemistry*. Springer.
- Chauhan B and Mahajan G. 2014. *Recent Advances in Weed Management*. Springer.
- Das TK. 2008. *Weed Science: Basics and Applications*, Jain Brothers (New Delhi).
- Fennimore, Steven A and Bell, Carl. 2014. *Principles of Weed Control*, 4th Ed, California Weed Sci. Soc.
- Gupta OP. 2007. *Weed Management: Principles and Practices*, 2nd Ed.
- Jugulan, Mithila (ed). 2017. *Biology, Physiology and Molecular Biology of Weeds*. CRC Press
- Monaco TJ, Weller SC and Ashton FM. 2014. *Weed Science Principles and Practices*, Wiley
- Powles SB and Shaner DL. 2001. *Herbicide Resistance and World Grains*, CRC Press.
- Walia US. 2006. *Weed Management*, Kalyani.
- Zimdahl RL. (ed). 2018. *Integrated Weed Management for Sustainable Agriculture*, B. D. Sci. Pub.

**I. Course Title : Principles and Practices of Water Management**

**II. Course Code : Agron 504**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

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

**V. Theory**

**Unit I**

Water and its role in plants; Irrigation: Definition and objectives, water resources and irrigation development in of India and concerned state, major irrigation projects, extent of area and crops irrigated in India and in different states.

**Unit II**

Field water cycle, water movement in soil and plants; transpiration; soil-waterplant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition. Water availability and its relationship with nutrient availability and loses.

**Unit III**

Soil, plant and meteorological factors determining water needs of crops, scheduling, depth and methods of irrigation; micro irrigation systems; deficit irrigation; fertigation; management of water in controlled environments and polyhouses. Irrigation efficiency and water use efficiency.

**Unit IV**

Water management of crop and cropping system, Quality of irrigation water and management of saline water for irrigation, water use efficiency, Crop water requirement- estimation of ET and effective rainfall; Water management of the major crops and cropping systems. Automated irrigation system.

**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; rain water management and its utilization for crop production.

**Unit VI**

Quality of irrigation water and management of saline water for irrigation, water management in problem soils

**Unit VII**

Soil moisture conservation, water harvesting, rain water management and its utilization for crop production.

**Unit VIII**

Hydroponics,

**Unit IX**

Water management of crops under climate change scenario.

**VI. Practical**

- Determination of Field capacity by field method
- Determination of Permanent Wilting Point by sunflower pot culture technique
- Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus
- Determination of Hygroscopic Coefficient
- Determination of maximum water holding capacity of soil
- Measurement of matric potential using gauge and mercury type tensiometer
- Determination of soil-moisture characteristics curves
- Determination of saturated hydraulic conductivity by constant and falling head method
- Determination of hydraulic conductivity of saturated soil below the water table by auger hole method
- Measurement of soil water diffusivity
- Estimation of unsaturated hydraulic conductivity
- Estimation of upward flux of water using tensiometer and from depth ground water table
- Determination of irrigation requirement of crops (calculations)
- Determination of effective rainfall (calculations)
- Determination of ET of crops by soil moisture depletion method
- Determination of water requirements of crops
- Measurement of irrigation water by volume and velocity-area method
- Measurement of irrigation water by measuring devices and calculation of irrigation efficiency
- Determination of infiltration rate by double ring infiltrometer

**VII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, assignment and field visit

*[Handwritten signatures and initials]*

### VIII. Learning outcome

Basic knowledge on water management for optimization of crop yield

### IX. Suggested Reading

- Majumdar DK. 2014. *Irrigation Water Management: Principles and Practice*. PHL Learning private publishers
- Mukund Joshi. 2013. *A Text Book of Irrigation and Water Management Hardcover*, Kalyani publishers
- 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 and Sandhu BS. 1987. *Irrigation of Food Crops - Principles and Practices*. ICAR.
- Reddy SR. 2000. *Principles of Crop Production*. Kalyani.
- Singh Pratap and Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publ.

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I. Course Title : Conservation Agriculture

II. Course Code : Agron 505

III. Credit Hours : 1+1

IV. Aim of the course

To impart knowledge of conservation of agriculture for economic development.

V. Theory

Unit I

Conventional and conservation agriculture systems, sustainability concerns, conservation agriculture: Historical background and present concept, global experiences, present status in India.

Unit II

Nutrient management in CA, water management, weed management, energy use, insect-pest and disease management, farm machinery, crop residue management, cover crop management.

Unit III

Climate change mitigation and CA, C-sequestration, soil health management, soil microbes and CA.

Unit IV

CA in agroforestry systems, rainfed / dryland regions

Unit V

Economic considerations in CA, adoption and constraints, CA: The future of agriculture

VI. Practicals

- Study of long-term experiments on CA,
- Evaluation of soil health parameters,
- Estimation of C-sequestration,
- Machinery calibration for sowing different crops, weed seedbank estimation under CA, energy requirements, economic analysis of CA.

VII. Teaching methods/activities

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

VIII. Learning outcome

Experience on the knowledge of various types of conservation of agriculture.

IX. Suggested Reading

- Arakeri HR and Roy D. 1984. *Principles of Soil Conservation and Water Management*. Oxford & IBH.
- Bisht JK, Meena VS, Mishra PK and Pattanayak A. 2016. *Conservation Agriculture-An approach to combat climate change in Indian Himalaya*. Publisher: Springer Nature. Doi: 10/1007/978-981-10-2558-7.
- Dhruvanarayana VV. 1993. *Soil and Water Conservation Research in India*. ICAR.
- FAO. 2004. *Soil and Water Conservation in Semi-Arid Areas*. *Soils Bull.*, Paper 57.
- Gracia-Torres L, Benites J, Martinez-Vilela A and Holgado-Cabera A. 2003. *Conservation Agriculture-Environment Farmers experiences, innovations Socio-economic policy*.
- Muhammad F and Kamdambot HMS. 2014. *Conservation Agriculture*. Publisher: Springer Cham Heidelberg, New York Dordrecht London. Doi: 10.1007/978-3-319-11620-4.
- Yellamanda Reddy T and Sankara Reddy GH. 1992. *Principles of Agronomy*. Kalyani.

I. Course Title : Agronomy of Major Cereals and Pulses

II. Course Code : Agron 506

III. Credit Hours : 2+0

IV. Aim of the course

To impart knowledge of crop husbandry of cereals and pulse crops.

V. 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.

VI. 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 (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
- 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 selected 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

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and class discussion

VIII. Learning outcome

Basic knowledge on cereals and pulse growing in the country .

IX. Resources

- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Hunsigi G and Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.
- Jeswani LM and Baldev B. 1997. *Advances in Pulse Production Technology*. ICAR.
- Khare D and Bhale MS. 2000. *Seed Technology*. Scientific Publ.
- Kumar Ranjeet and Singh NP. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
- Pal M, Deka J and 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 and Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
- Singh SS. 1998. *Crop Management*. Kalyani.
- Yadav DS. 1992. *Pulse Crops*. Kalyani.



**I. Course Title : Agronomy of Oilseed, Fibre and Sugar Crops**

**II. Course Code : Agron 507**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

To teach the crop husbandry of oilseed, fiber and sugar crops

**V. Theory**

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 maximum production of:

**Unit I**

Rabi oilseeds – Rapeseed and mustard, Linseed and Niger

**Unit II**

Kharif oilseeds - Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower

**Unit III**

Fiber crops - Cotton, Jute, Ramie and Mesta.

**Unit IV**

Sugar crops – Sugar-beet and Sugarcane.

**VI. Practical**

- Planning and layout of field experiments
- Cutting of sugarcane setts, 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 (CGR, RGR, NAR, LAI, LAD, LAR, LWR, SLA, SLW etc)
- Assessment of land use and yield advantage (Rotational intensity, Cropping intensity, Diversity Index, Sustainable Yield Index Crop Equivalent Yield, Land Equivalent ration, Aggressiveness, Relative Crowding Coefficient, Competition Ratio and ATER etc)
- 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 fibre of different fibre 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

**VIII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, assignment and class discussion

**IX. Learning outcome**

Basic knowledge on production of oil seed, sugar and fibre crops.

**X. Suggested Reading**

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


**I. Course Title : Agronomy of Medicinal, Aromatic and Under Utilized Crops**

**II. Course Code : Agron 508/PSMA 503**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

To acquaint students about different medicinal, aromatic and underutilized field crops, their package of practices and processing.

**V. Theory**

**Unit I**

Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according to botanical characteristics and their uses, export potential and indigenous technical knowledge.

**Unit II**

Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Mulhati, Isabgol, Rauwolfia, Poppy, *Aloe vera*, Satavar, *Stevia*, Safed Musli, Kalmegh, Asaphoetida, *Nuxvomica*, Rosadlc. etc).

**Unit III**

Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium).

**Unit IV**

Climate and soil requirements; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, Sesbania, Clusterbean, French bean, Fenugreek, Grain Amaranth, Coffee, Tea and Tobacco).

**Unit V**

Post harvest handling –drawing, processing, grading, packing and storage, value addition and quality standards in herbal products.

**VI. Practical**

- Identification of crops based on morphological and seed characteristics
- Raising of herbarium of medicinal, aromatic and under-utilized plants
- Quality characters in medicinal and aromatic plants
- Methods of analysis of essential oil and other chemicals of importance in medicinal and aromatic plants.

**VII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, assignment and field visit

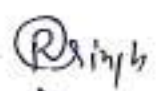

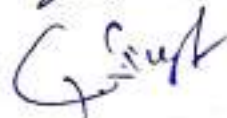
**VIII. Learning outcome**

Acquainted with various MAP and their commercial base for developing entrepreneurship.

**IX. Suggested Reading**

- Chadha KL and Gupta R. 1995. *Advances in Horticulture*. Vol. II. *Medicinal and Aromatic Plants*. Malhotra Publ.
- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Handa SS. 1984. *Cultivation and Utilization of Medicinal Plants*. RRL, CSIR, Jammu.
- Hussain A. 1984. *Essential Oil Plants and their Cultivation*. CIMAP, Lucknow.
- Hussain A. 1993. *Medicinal Plants and their Cultivation*. CIMAP, Lucknow.
- ICAR 2006. *Hand Book of Agriculture*. ICAR, New Delhi.
- Kumar N, Khader Md. Abdul, Rangaswami JBM & Irulappan 1997. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants*. Oxford & IBH.
- Prajapati ND, Purohit SS, Sharma AK and Kumar T. 2003. *A Hand Book of Medicinal Plants: A Complete Source Book*. Agrobios.
- Sharma R. 2004. *Agro-Techniques of Medicinal Plants*. Daya Publ. House.

**I. Course Title : Agronomy of Fodder and Forage Crops**

**II. Course Code : Agron 509**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

To teach the crop husbandry of different forage and fodder crops along with their processing.

**V. Theory**

**Unit I**

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like sorghum, maize, *bajra*, *guar*, cowpea, oats, barley, berseem, *senji*, lucerne, etc.

**Unit II**

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasses like Napier grass, *Panicum*, *Lasiurus*, *Cenchrus*, etc.

**Unit III**

Year-round fodder production and management, preservation and utilization of forage and pasture crops.

**Unit IV**

Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor quality fodder. Fodder production through hydroponics. Azolla cultivation.

**Unit V**

Economics of forage cultivation uses and seed production techniques of important fodder crops.

**VI. Practical**

- Practical training of farm operations in raising fodder crops;
- Canopy measurement, yield, Leaf: Stem ratio and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose and IVDMD, etc. of various fodder and forage crops
- Anti-quality components like HCN in sorghum and such factors in other crops
- Hay and silage making and economics of their preparation.

**VII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, assignment and field visit

**VIII. Learning outcome**

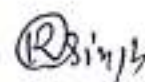
Acquainted with various fodder and forage crops and their commercial base for developing entrepreneurship.

**IX. Suggested Reading**

- Chatterjee BN. 1989. *Forage Crop Production - Principles and Practices*. Oxford & IBH.
- Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
- Narayanan TR and Dabudghao PM. 1972. *Forage Crops of India*. ICAR.
- Singh P and Srivastava AK. 1990. *Forage Production Technology*. IGFRI, Jhansi.
- Singh C, Singh P and Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
- Tejwani KG. 1994. *Agroforestry in India*. Oxford & IBH.

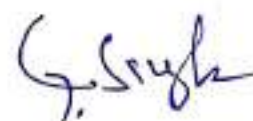












I. Course Title : Agrostology and Agro-forestry (To be taught jointly by Agronomy and Forestry)

II. Course Code : Agron 510

III. Credit Hours : 2+1

IV. Theory

V. Aim of the course

To teach crop husbandry of different forage, fodder and agroforestry crops/trees along with their processing.

Unit I

Agrostology: definition and importance; principles of grassland ecology: grassland ecology – community, climax, dominant species, succession, biotype, ecological status of grasslands in India, grass cover of India; problems and management of grasslands.

Unit II

Importance, classification (various criteria), scope, status and research needs of pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.

Unit III

Agroforestry: definition and importance; agroforestry systems, agrisilviculture, silvipasture, agrisilvipasture, agrihorticulture, aquasilviculture, alley cropping and energy plantation.

Unit IV

Crop production technology in agro-forestry and agrostology system; silvipastoral system: meaning and importance for wasteland development; selection of species, planting methods and problems of seed germination in agro-forestry systems; irrigation and manuring in agro-forestry systems, associative influence in relation to above ground and underground interferences; lopping and coppicing in agroforestry systems; social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics.

VI. Practical

- Preparation of charts and maps of India showing different types of pastures and agro-forestry systems
- Identification of seeds and plants of common grasses, legumes and trees of economic importance with reference to agro-forestry
- Seed treatment for better germination of farm vegetation
- Methods of propagation/ planting of grasses and trees in silvipastoral system
- Fertilizer application in strip and silvipastoral systems
- After-care of plantation
- Estimation of protein content in loppings of important fodder trees
- Estimation of caloric value of wood of important fuel trees
- Estimation of total biomass and fuel wood
- Economics of agro-forestry
- Visit to important agro-forestry research stations

VII. Teaching methods/activities

Classroom teaching with AV aids, group discussion, assignment and field visit

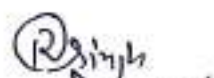
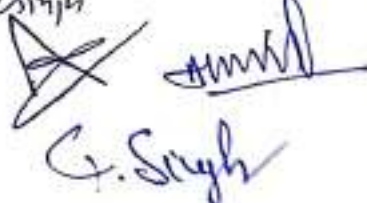
VIII. Learning outcome

Basic knowledge on agro forestry, forage crops and their utility

IX. Suggested Reading

- Chatterjee BN and Das PK. 1989. *Forage Crop Production. Principles and Practices*. Oxford & IBH.
- Dabadghao PM and Shankaranarayan KA. 1973. *The Grass Cover in India*. ICAR.
- Dwivedi AP. 1992. *Agroforestry- Principles and Practices*. Oxford & IBH.
- Indian Society of Agronomy. 1989. *Agroforestry System in India. Research and Development*, New Delhi.
- Narayan TR and Dabadghao PM. 1972. *Forage Crop of India*. ICAR, New Delhi.

**I. Course Title : Cropping Systems and Sustainable Agriculture**

**II. Course Code : Agron 511**

**III. Credit Hours : 2+0**

**IV. Aim of the course**

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

**V. 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. Advanced nutritional tools for big data analysis and interpretation.

**Unit V**

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

**Unit VI**

Artificial Intelligence- Concept and application.

**VII. Teaching methods/ activities**

Classroom teaching with AV aids, group discussion, assignment.

**VIII. Learning outcome**

Basic knowledge on cropping system for sustainable agriculture.

**IX. Suggested Reading**

- Panda SC. 2017. *Cropping Systems and Sustainable Agriculture*. Agrobios (India)
- Panda SC. 2018. *Cropping and Farming Systems*. Agrobios.
- Palaniappan SP and 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 and 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 and Havlin JL. 1997. *Soil Fertility and Fertilizers*. Prentice Hall.


**I. Course Title : Dryland Farming and Watershed Management**

**II. Course Code. : Agron 512**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

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

**V. 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.

**VI. Practical**

- Method of Seed Priming
- Determination of moisture content of germination of important dryland crops
- Determination of Relative Water Content and Saturation Deficit of Leaf
- Moisture stress effects and recovery behaviour of important crops
- Estimation of Potential ET by Thornthwaite method
- Estimation of Reference ET by Penman Monteith Method
- Classification of climate by Thornthwaite method (based on moisture index, humidity index and aridity index)
- Classification of climate by Koppen Method
- Estimation of water balance by Thornthwaite method
- Estimation of water balance by FAO method
- Assessment of drought
- Estimation of length of growing period
- Estimation of probability of rain and crop planning for different drought condition
- Spray of anti-transpirants and their effect on crops
- Water use efficiency
- Visit to dryland research stations and watershed projects

**VII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, assignment.

**VIII. Learning outcome**

Basic knowledge on dry land farming and soil moisture conservation.

**IX. Suggested Reading**

- Reddy TY. 2018. *Dryland Agriculture Principles and Practices*, Kalyani publishers
- Das NR. 2007. *Tillage and Crop Production*. Scientific Publ.
- 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 and Farrington J. 1995. *Research for Rainfed Farming*. CRIDA.
- Rao SC and Ryan J. 2007. *Challenges and Strategies of Dryland Agriculture*. Scientific Publ.
- Singh P and Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publ. Company.
- Singh RP. 1988. *Improved Agronomic Practices for Dryland Crops*. CRIDA.
- Singh RP. 2005. *Sustainable Development of Dryland Agriculture in India*. Scientific Publ.

**I. Course Title : Principles and Practices of Organic Farming**

**II. Course Code : Agron 513**

**III. Credit Hours : 2+1**

**IV. Aim of the course**

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

**V. Theory**

**Unit I**

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; principles of organic agriculture; organics and farming standards; organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation 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, bio-fertilizers and biogas technology.

**Unit III**

Farming systems, selection of crops and 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, bio-pesticides.

**Unit V**

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

**VI. Practical**

- Method of making compost by aerobic method
- Method of making compost by anaerobic method
- Method of making 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 a biogas plant
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

**VII. Teaching methods/activities**

Classroom teaching with AV aids, group discussion, assignment, exposure visit

**VIII. Learning outcome**

Basic knowledge on organic farming for sustainable agriculture and development of entrepreneurship on organic inputs.

**IX. Suggested Reading**

- Ananthakrishnan TN. (Ed.). 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.
- Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.
- Joshi M. 2016. *New Vistas of Organic Farming*. Scientific Publishers
- Lampin N. 1990. *Organic Farming*. Press Books, Ipswich, UK.
- Palaniappan SP and Ananduraj K. 1999. *Organic Farming - Theory and Practice*. Scientific Publ.
- Rao BV Venkata. 1995. *Small Farmer Focused Integrated Rural Development: Socio economic Environment and Legal Perspective*: Publ.3, ParisaraprajnaParishutana, Bangalore.
- Reddy MV. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
- Sharma A. 2002. *Hand Book of Organic Farming*. Agrobios.
- Singh SP. (Ed.). 1994. *Technology for Production of Natural Enemies*. PDBC, Bangalore.
- Subba Rao NS. 2002. *Soil Microbiology*. Oxford & IBH.
- Trivedi RN. 1993. *A Text Book of Environmental Sciences*, Anmol Publ.
- Veeresh GK, Shivashankar K and Suiglachar MA. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.
- WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*. WHO.

कमला नेहरू भौतिक एवं सामाजिक विज्ञान संस्थान, सुलतानपुर-228118

KAMLA NEHRU INSTITUTE OF PHYSICAL & SOCIAL SCIENCES SULTANPUR-228118

(FACULTY OF AGRICULTURE, SULTANPUR U.P.)

POST GRADUATE CURRICULAR & SYLLABUS

**M.Sc. Ag. Agronomy**

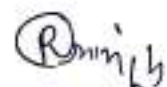
**(Minor Courses)**

Code No.	Course Title	Credit Hours
SS-509	Analytical technique and instrumental methods in soil and plant analysis	2 (0+2)
SS-507	Soil Water and Air Pollution	3 (2+1)
SS-505	Soil Erosion & Conservation	3 (2+1)

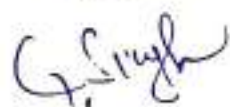














**I. Course Title** : Analytical Technique and Instrumental Methods in Soil and Plant Analysis

**II. Course Code** : SS 509

**III. Credit Hours** : 0+2

**IV. Aim of the course**

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.

**V. Practical**

**Unit I**

Preparation of solutions for standard curves, 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, ultra violet 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, CHNS analyzer.

**Unit IV**

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

**Unit V**

Wet digestion/fusion/extraction of soil with aquaregia with soil for elemental analysis; triacid/di-acid digestion of plant samples; determination of available and total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in soils; determination of total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in plants

**Unit VI**

Drawing normalized exchange isotherms; measurement of redox potential.

**VI. Teaching methods/activities**

Classroom teaching and laboratory Practicals


## VII. Learning outcome

Development of confidence for setting soil testing laboratory.

## VIII. Suggested Reading

- 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 and Keeney DR. 1982. *Methods of Soil Analysis*. Part II. SSSA, Madison.
- Piper CE. *Soil and Plant Analysis*. Hans Publ.
- Singh D, Chhonkar PK and 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.


- I. Course Title** : Soil, Water and Air Pollution  
**II. Course Code** : SS 507  
**III. Credit Hours** : 2+1

**IV. Aim of the course**

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

**V. 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, behaviour in soil and effect on soil microorganisms.

**Unit V**

Toxic elements—their sources, behaviour 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 VII**

Risk assessment of polluted soil, Remediation/ amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

**VI. Practical**

Sampling of sewage waters, sewage sludge, solid/ liquid industrial wastes, polluted soils and plants and their processing, Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD),

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measurement of coliform (MPN), 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 safe guard food safety, Air sampling and determination of particulate matter and oxides of Sulphur, NO<sub>2</sub> and O<sub>2</sub> conc. Visit to various industrial sites to study the impact of pollutants on soil and plants.

#### VII. Teaching methods/activities

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

#### VIII. Learning outcome

Management of soil and water pollution

#### IX. Suggested Reading

- Lal R, Kimble J, Levine E and Stewart BA. 1995. *Soil Management and Greenhouse Effect*. CRC Press.
- Middlebrooks EJ. 1979. *Industrial Pollution Control*. Vol. 1. *Agro-Industries*. John Wiley Interscience.
- Ross SM. *Toxic Metals in Soil Plant Systems*. John Wiley & Sons.
- Vesilund PA and Pierce 1983. *Environmental Pollution and Control*. Ann Arbor SciencePubl.


**I. Course Title** : Soil Erosion and Conservation  
**II. Course Code** : SS 505  
**III. Credit Hours** : 2+1

**IV. Aim of the course**

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

**V. Theory**

**VI. 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, sediment measurement

**VII. 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
- Land capability classification of a watershed
- Visits to a watersheds

#### VIII. Teaching methods/activities

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

#### IX. Learning outcome

Experience on the knowledge of soil conservation and their utility in research for solving field problem.

#### X. Suggested Reading

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

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Supporting Courses

Course Code	Course Title	Credit Hours
STAT 502	Statistical Methods for Applied Sciences	4(3+1)
STAT 511	Experimental Designs	3(2+1)

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**Course Title :** Statistical Methods for Applied Sciences

**Course Code :** STAT 502

**Credit Hours :** 4(3+1)

### Theory

**Unit I** Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation.

**Unit II** Discrete and continuous probability distributions, 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.

**Unit III** Introduction to theory of estimation and confidence-intervals, Simple and multiple correlation coefficient, partial correlation, rank correlation, Simple and multiple linear regression model, test of significance of correlation coefficient and regression coefficients, Coefficient of determination, Fitting of quadratic models.

**Unit IV** Non-parametric tests – sign, Wilcoxon, Mann-Whitney U-test, Run test for the randomness of a sequence. Median test.

**Unit V** Introduction to ANOVA: One way and Two Way, Introduction to Sampling Techniques, Introduction to Multivariate Analysis, Transformation of Data.

### Practical

- Exploratory data analysis, 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 Correlation and regression analysis, fitting of Linear and Quadratic Model.
- Non-parametric tests. ANOVA: One way, Two Way, SRS.

### Suggested Reading

- Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
- Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
- Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
- Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.

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- Morrison D.P. 1976. Multivariate Statistical Methods. McGraw Hill.
- Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
- Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.
- Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed . John Wiley
- <http://freeststatistics.altervista.org/en/learning.php>.
- <http://www.statsoft.com/textbook/stathome.html>.

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**Course Title :** Experimental Designs

**Course Code :** STAT 511

**Credit Hours :** 3(2+1)

### 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. Concept of confounding.

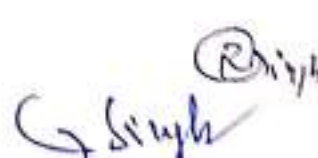
**Unit IV** Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications, Lattice design, alpha design - concepts. randomization procedure, analysis and interpretation of results. Response surfaces. Combined analysis.

### 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,
- Analysis with missing data,
- Split plot and strip plot designs.

### Suggested Reading

- Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
- Montgomery DC. 2012. Design and Analysis of Experiments, 8th Ed. John Wiley.
- Federer WT. 1985. Experimental Designs. MacMillan.
- Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK and 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.
- [www.drs.icar.gov.in](http://www.drs.icar.gov.in)



## Common Courses

### PGS 501 Library and Information Services

(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-ROMs databases, online public access catalogue and other computerized library services; use of internet including search engines and its resources; eresources access methods.

### PGS 502 Technical Writing and Communications Skills

(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

1. Barnes and Noble. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
2. *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
3. *Collins' Cobuild English Dictionary*. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. *Technical Writing*. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
6. James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
7. Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
8. Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
9. Richard WS. 1969. *Technical Writing*.
10. Sethi J and Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
11. Wren PC and Martin H. 2006. *High School English Grammar and Composition*. S. Chand & Co.

### PGS 503 Intellectual Property and Its Management in Agriculture

(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

1. Erbisch FH and Maredia K. 1998. *Intellectual Property Rights in Agricultural Biotechnology*. CABI.
2. Ganguli P. 2001. *Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
3. *Intellectual Property Rights: Key to New Wealth Generation*. 2001. NRDC and Aesthetic Technologies.
4. Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
5. Rothschild M and Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.

6. 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; The Biological Diversity Act, 2002.

### PGS 504 Basic Concepts in Laboratory Techniques

(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 vaccupets;
- 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

1. Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
2. Gabb MH and Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

### PGS 505 Agricultural Research, Research Ethics and Rural Development Programmes

(1+0)

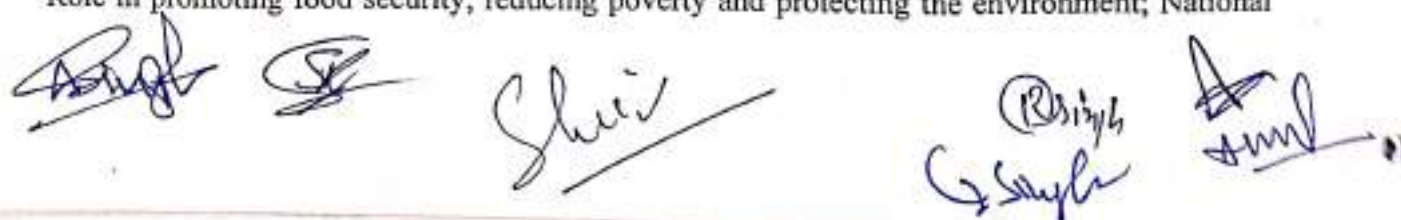
#### Objective

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.

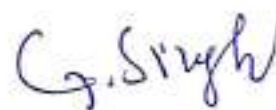
### Suggested Readings

1. Bhalla GS and Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
2. Punia MS. *Manual on International Research and Research Ethics*. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.
4. Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.





Common courses

Course Code	Course Title	Credit Hours
PGSS 501	Library and Information Services	1(0+1)
PGSS 502	Technical Writing and Communications Skills	1(0+1)
PGSS 503	Intellectual Property and its management in Agriculture	1(1+0)
PGSS 504	Basic Concepts in Laboratory Techniques	1(0+1)
PGSS 505	Agricultural Research, Research Ethics and Rural Development Programmes	1(1+0)

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