

# **Agronomy**

(Under Semester System as Per ICAR Recommended)

# **Syllabus**

**Academic Session- 2022-24**



**Jananayak Chandrashekhar University, Ballia  
Uttar Pradesh**

## Preamble

Agronomy is a discipline which deals with various processes such as cultivation, intercultural, management of field through various measures like weed management, soil fertility development, and proper use of water resources and so on. Agronomy has a major component of agro ecology which includes several activities that affect the environment and human population. An Agronomist remains in the centre of effort to work with issues related to environmental and ecological concerns and to increase the production of food, feed, fuels and fiber for growing population in world. Agronomists today are involved with many issues including producing food, creating healthier food, managing environmental impacts and creating energy from plants. Research activities in Agronomy focus on system analysis and simulation modeling of environmental and management impacts on agricultural production, these are key to the sustainability of agricultural production system.

Hence, it is very much essential to revise the course curriculum of Agronomy so that students even teachers may be well acquainted with the present concept of development of the discipline. This will help bringing competency in students along with confidence so as to develop himself / herself for being tackling field problems and management of land. The existing M.Sc. (Ag) courses of Agronomy have been modified taking into account of present day need by incorporating the necessary and important topics in the respective courses.

Minor changes have been made in most of the existing courses. As a part of course curriculum, M. Sc.(Ag) Agronomy was restructured to equip students to tackle emerging issues by inclusion of one new course on "Conservation agriculture". All the Ph.D courses of Agronomy was slightly revised by adding/ deleting some portion in the existing courses. The course "Fundamentals of Meteorology" is dropped from Agronomy department and interested students can take the course from department of Agri. Meteorology. The course "Agro ecology" offered by the department for Ph.D. programme is also dropped. Similarly, the Ph.D. course "Crop production and system modeling" is also deleted and the contents are merged with Agron601, i.e. "Current trends in Agronomy".

It was proposed by some members to include new courses like "Seed production technology", "Experimental technique in Agronomy" and "Management of Problem soils and water". But finally, it was decided that these courses should be offered by the core departments such as Department of Seed Technology, Department of Statistics and Department of Soil Science, respectively. There are few courses in the existing syllabus which are not offered by in many universities. Hence these courses are merged and there by reduced the number of courses to limit choices that complete knowledge of the subject can be given to the students. In all the courses, the practical aspects are strengthened.

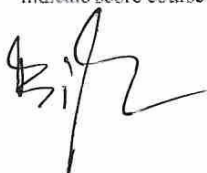
Topics such as automated irrigation systems, value chain addition/post-harvest processing, variable rate application, precision farming, protected agriculture, soil less farming, farm mechanization of practical operations, practical applications of advanced tools for big data analysis and interpretation, artificial intelligence, drone set care included in the revised syllabus so that students can show competency at national and international level.



## M.Sc. (Ag.) Agronomy

Course Code	Course Title	Credit Hours
AGR 501*	Modern Concepts in Crop Production	3+0
AGR502	Agronomy of Major Cereals and Pulses	2+0
HOR 503	Production of Cool Season Vegetable Crops	2+1
<del>PGS</del> 504	Intellectual Property and Its Management	1+0
STAT505	Experimental Design	2+1
AGR506*	Principles and Practices of soil fertility and nutrient management	2+1
AGR 507	Agronomy of oilseed, fibre and sugar crops	2+1
HOR 508	Production of Warm Season Vegetable Crops	2+1
PGS 509	Basic concepts in laboratory techniques	0+1
MCA510	Information Technology in agriculture	1+1
AGR 511*	Principle and practices of water management	2+1
AGR 512	Agronomy of fodder and forage crops	2+1
HOR513	Growth and Development of Vegetable Crops	2+1
PGS514	Technical writing and communication skills	0+1
PGS 515	Agricultural research, research ethics and rural development programmes	0+1
AGR 516*	Principles and practices weed management	2+1
PGS 517	Library and information services	1+0
AGR 550	Seminar	1
AGR 560	Thesis research	30

\*Indicate score course which is Compulsory course for MSc. (Agri.)



1 <sup>st</sup> Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
AGR 501	Modern Concepts in Crop Production	3+0	25	50	25	100
AGR 502	Agronomy of Major Cereals and Pulses	2+0	25	50	25	100
HOR 503	Production of Cool Season Vegetable Crops	2+1	25	50	25	100
PGS 504	Intellectual Property and Its Management	1+0	25	50	25	100
STAT 505	Experimental Design	2+1	25	50	25	100
<b>Total Credits</b>		<b>12</b>	<b>-</b>			

2 <sup>nd</sup> Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
AGR 506	Principles and Practices of soil fertility and nutrient management	2+1	25	50	25	100
AGR 507	Agronomy of oilseed, fibre and sugar crops	2+1	25	50	25	100
HOR 508	Production of Warm Season Vegetable Crops	2+1	25	50	25	100
PGS 509	Basic concepts in laboratory techniques	0+1	25	50	25	100
MCA 510	Information Technology in agriculture	1+1	25	50	25	100
<b>Total Credits</b>		<b>12</b>	<b>-</b>			

3 <sup>rd</sup> Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
AGR 511	Principle and practices of water management	2+1	25	50	25	100
AGR 512	Agronomy of fodder and forage crops	2+1	25	50	25	100
HOR 513	Growth and Development of Vegetable Crops	2+1	25	50	25	100
PGS 514	Technical writing and communication skills	0+1	25	50	25	100
PGS 515	Agricultural research, research ethics and rural development programmes	0+1	25	50	25	100
<b>Total Credits</b>		<b>11</b>	<b>-</b>			

4 <sup>th</sup> Semester						Evaluation Marks
Code No.	Course Title	Credit Hours	Mid Term	End Term	Practical	Total
AGR 516	Principles and practices weed management	2+1	25	50	25	100
PGS 517	Library and information services	1+0	25	50	25	100
AGR 550	Seminar	1				
AGR 560	Thesis research	30				
<b>Total Credits</b>		<b>35</b>	<b>-</b>			
<b>Total Semester Credit Hours</b>		<b>70</b>				

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# M.Sc. (Ag.) Agronomy

## First Semester

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

**II. Course Code: AGR 501**

**III. Credit Hours : 3+0**

**IV. Need 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: soilless cultivation, Aeroponic, Hydroponic, Robotic and terrace farming. use of GIS, GPS and remote sensing in modern agriculture, precision farming and protected agriculture.

**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



- Ed. PrenticeHall.
- 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. Eco physiology 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 : Agronomy of Major Cereal sand Pulses**

**II. Course Code : AGR 502**

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

**IV. Need 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 near by 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 once real sand pulse growing in the country.

## IX. Resources

- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Hunsigi Gand 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, NewDelhi.
- Pal M, Deka J and Rai RK. 1996. Fundamentals of Cereal Crop Production. Tata Mc Graw 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 D S. 1992. Pulse Crops. Kalyani.
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- **CourseTitle** : **Production of Cool Season Vegetable Crops**
- **CourseCode** : **HOR503**
- **CreditHours** : **(2+1)**
- **Need of course?**

Cool season vegetables are a major source of dietary fibres, minerals and vitamins. Some of these vegetables also contribute protein, fat and carbohydrate. Most of the leafy and root vegetables are rich in minerals, especially in micro-elements such as copper, manganese and zinc. Vegetables differ in their temperature requirement for proper growth and development. Most of the winter vegetable crops are cultivated in cool season when the monthly mean temperature does not exceed 21°C. Even in temperate climate, these vegetables are cultivated in spring summer in hilly



tracks where the day time temperature in summer is less than 21°C. The students of vegetable science need to have an understanding of production technology of important cool season vegetable crops and their management.

- **Objective of Course**

To impart knowledge and skills on advancement in production technology of cool season vegetable crops

The course is constructed given as under:

No. Block	Unit
• Production of cool season vegetable Bulb and tuber crops	I II Cole crops • Root crops • Peas and beans V Leafy vegetables

- **Theory**

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/hybrids, seed rate and seed treatment, raising of nursery, sowing/ planting time and methods, hydroponics and aeroponics, precision farming, cropping system, nutritional including micronutrients and irrigation requirements, intercultural operations, special horticultural practices, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marketing), pest and disease management and production economics of crops.

**Unit I**

*Bulb and tuber crops*—Onion, garlic and potato.

*Cole crops*—Cabbage, cauliflower, kohlrabi, broccoli, Brussels sprouts and kale.

**Unit III**

*Root crops*—Carrot, radish, turnip and beetroot.

**Unit IV**

*Peas and beans*—Garden peas and broad bean.

**Unit V**

*Leafy vegetables*—Beet leaf, fenugreek, coriander and lettuce.

- **Practical**

- Scientific raising of nursery and seed treatment;
- Sowing and transplanting;
- Description of commercial varieties and hybrids;
- Demonstration on methods of irrigation, fertilizers and micronutrients application;
- Mulching practices, weed management;
- Use of plant growth substances in cool season vegetable crops;
- Study of nutritional and physiological disorders;
- Studies on hydroponics, aeroponics and other soilless culture;
- Identification of important pest and diseases and their control;
- Preparation of cropping scheme for commercial farms;
- Visit to commercial farm, greenhouse/polyhouses;



- Visittovegetablemarket;
- Analysisofbenefittostratio.
- **TeachingMethods/Activities**
  - Classroomlectures
  - Assignment(writtenandspeaking)
  - Studentpresentation
  - Handsontainingofdifferentprocedures
  - Groupdiscussion
- **Learningoutcome**  
Aftersuccessfulcompletionofthiscourse,thestudentsareexpectedto:
  - Appreciatethe scope andscenario of coolseason vegetable cropsin India
  - Acquireknowledgeabouttheproductiontechnologyandpost-harvesthandlingofcoolseasonvegetablecrops
  - CalculatetheeconomicsofvegetableproductioninIndia

- **SuggestedReading**

- BoseTK,KabirJ,MaityTK,ParthasarathyVAandSomMG.2003.*Vegetablecrops*.Vols.I-III.Nayaudyog.
- BoseTK, Som MG and Kabir J. (Eds.). 1993.*Vegetablecrops*. Naya prokash.
- ChadhaKLandKallooG.(Eds.).1993-94.*Advancesinhorticulture*Vols.V-X.Malhotrapubl.house.
- ChadhaKL.(Ed.).2002.*Handbookofhorticulture*.ICAR.
- ChauhanDVS.(Ed.).1986.*VegetableproductioninIndia*.Ramprasadandsons.
- FageriaMS,ChoudharyBRandDhakaRS.2000.*Vegetablecrops:productiontechnology*.Vol. II.Kalyanipublishers.
- GopalakrishananTR.2007.*Vegetablecrops*.NewIndiapubl.agency.
- HazraPandBanerjeeMKandChattopadhyayA.2012.*VarietiesofvegetablecropsinIndia*, (Secondedition),Kalyanipublishers,Ludhiana,199p.
- HazraP.2016.*VegetableScience*.2<sup>nd</sup>edn,Kalyanipublishers,Ludhiana.
- HazraP.2019.*Vegetableproductionandtechnology*.NewIndiapublishingagency,NewDelhi.
- HazraP,ChattopadhyayA,KarmakarKandDuttaS.2011.*Moderntechnologyforvegetableproduction*,NewIndiapublishingagency,NewDelhi,413p
- RanaMK.2008.*OlericultureinIndia*.Kalyanipublishers,NewDelhi.
- Rana MK. 2008.  
*Scientificcultivationofvegetables*.Kalyanipublishers,NewDelhi.RanaMK.2014.*Technologyforvegetableproduction*.Kalyanipublishers,NewDelhi.
- RubatzkyVEandYamaguchiM.(Eds.).1997.*Worldvegetables:principles,productionandnutritivevalues*.ChapmanandHall.
- SainiGS.2001.*Atextbookofoleriandfloriculture*.Amanpublishinghouse.
- SalunkheDKandKadamSS.(Ed.).1998.*Handbookofvegetablescienceandtechnology:production,composition,storageandprocessing*.Marceldekker.
- ShanmugaveluKG.1989.*Productiontechnologyofvegetablecrops*.OxfordandIBH.
- SinghDK.2007.*Modernvegetablevarietiesandproductiontechnology*.InternationalbookdistributingCo.
- SinghSP.(Ed.).1989.*Productiontechnologyofvegetablecrops*.Agril.comm.res.centre.Thamburaj S and Singh N. (Eds.), 2004. *Vegetables, tuber crops and spices*. ICAR.ThompsonHCandKellyWC.(Eds.).1978.*Vegetablecrops*.TataMcGraw-Hill.

**CourseTitle** :Intellectual property and management In agriculture  
**CourseCode** :PGS 504  
**CreditHours** :1+0

**Objective of Course**

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.

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## 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), benefit 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

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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.

#### **I. Course Title : Experimental Designs**

#### **II. Course Code : STAT 505**

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

#### **IV. Need of the course**

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

#### **V. 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.

#### **VI. 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.

#### **VII. Suggested Reading**

- Cochran WG and Cox GM. 1957. Experimental Designs. 2<sup>nd</sup> Ed. John Wiley.
- Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
- Montgomery DC. 2012. Design and Analysis of Experiments, 8<sup>th</sup> 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.

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## Second Semester

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

**II. Course Code** : AGR 506

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

**IV. Objective 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. Soilless 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 vermin compost 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 A/V 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. 7th 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** : Agronomy of Oilseed, Fibre and Sugar Crops

**II. Course Code** : AGR 507

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

## IV. Aim of the course

To teach the crop husbandry of oilseed, fibre 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

Khari oilseeds – Groundnut, Sesame, Castor, Sunflower, Soybean and Safflower

### Unit III

Fibre 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 sets, its treatment and methods of sowing, tying and propping of sugarcane
- Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop
- Intercultural operations in different crops

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- Cottonseed 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 ratio, 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 oil seeds 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 A V 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. Oil seed Crops of India. Kalyani.
- Lakshmi Kantam 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 Field Crops. Oxford & IBH.
- Singh SS. 1998. Crop Management. Kalyani.

- Group discussion

#### IX. Learning outcome

After successful completion of this course, the students are expected to:

- Acquire knowledge about the principles of vegetable breeding
- Improve yield, quality, abiotic and biotic resistance, other important traits of vegetable crops
- Understand how the basic principles are important to start breeding of vegetable crops

#### X. Suggested Reading

- Allard RW. 1960. Principle of plant breeding. John Wiley and Sons, USA. Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, FI, USA.
- Kole CR. 2007. Genom mapping and molecular breeding in plants-vegetables. Springer, USA. Peter KV and Pradcep Kumar T. 1998. Genetics and breeding of vegetables. ICAR, New Delhi, p. 488.
- Prohens J and Nuez F. 2007. Handbook of plant breeding-vegetables (Vol I and II). Springer, USA.
- Singh BD. 2007. Plant breeding-principles and methods (8th edn.). Kalyani Publishers, New Delhi.
- Singh Ran J. 2007. Genetic resources, chromosome engineering, and crop improvement-vegetable crops (Vol. 3). CRC Press, FI, USA.

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- **Course Title** : Production of Warm Season Vegetable Crops
- **Course Code** : HOR 508
- **Credit Hours** : (2+1)
- **Need of the course?**

Unlike cool-season vegetables, warm-season vegetable crops require higher soil and air temperature, thus, they are always planted after the last frost date ranging from late spring after the last frost date to late summer. Daytime temperature may still be warm enough but drop so much at night-time that the weather is not suitable for warm-season crops any longer. In general, summer vegetables require a little higher temperature than winter vegetables for optimum growth. In summer vegetables, the edible portion is mostly botanical fruit. The students of vegetable science need to have an understanding of production technology of important warm-season vegetable crops and thereafter their management.

- **Object of the course**

To impart knowledge and skills on advancement in production technology of warm-season vegetable crops

The course is constructed given as under:

No. Block	Unit
• Production of warm-season vegetable	1. Fruit vegetables crops
2. Beans	<ul style="list-style-type: none"> <li>• Cucurbits</li> <li>• Tuber crops</li> <li>• Leafy vegetables</li> </ul>

- **Theory**

Introduction, commercial and nutritional importance, origin and distribution, botany and taxonomy, area, production, productivity and constraints, soil requirements, climatic factors for yield and quality, commercial varieties/hybrids, seed rate and

seed treatment, raising of nursery including grafting technique, sowing/ planting time and methods, precision farming, cropping system, nutritional including micronutrients and irrigation requirements, inter-cultural operations, special horticultural practices namely hydroponics, aeroponics, weed control, mulching, role of plant growth regulators, physiological disorders, maturity indices, harvesting, yield, post-harvest management (grading, packaging and marking), pest and disease management and economics of crops.

**Unit I**

*Fruit vegetables*—Tomato, brinjal, hot pepper, sweet pepper and okra.

**Unit II**

*Beans*—French bean, Indian bean (Sem), cluster bean and cowpea.

**Unit III**

*Cucurbits*—Cucumber, melons, gourds, pumpkin and squashes.

**Unit IV**

*Tuber crops*—Sweet potato, elephant foot yam, tapioca, taro and yam.

**Unit V**



*Leafy vegetables*—Amaranth and drumstick.

• **Practical**

- Scientific raising of nursery and seed treatment;
- Sowing, transplanting, vegetable grafting;
- Description of commercial varieties and hybrids;
- Demonstration on methods of irrigation, fertilizers and micronutrients application;
- Mulching practices, weed management;
- Use of plant growth substances in warm season vegetable crops;
- Study of nutritional and physiological disorders;
- Studies on hydroponics, aeroponics and other soilless culture;
- Identification of important pest and diseases and their control;
- Preparation of cropping scheme for commercial farms;
- Visit to commercial farm, greenhouse/polyhouses;
- Visit to vegetable market;
- Analysis of benefit to cost ratio.

• **Teaching Methods/Activities**

- Classroom Lectures
- Assignment (written and speaking)
- Student presentation
- Hands on training of different procedures
- Group discussion

• **Learning outcome**

After successful completion of this course, the students are expected to:

- Appreciate the scope and scenario of warm season vegetable crops in India
- Acquire knowledge about the production technology and post-harvest handling of warm season vegetable crops
- Calculate the economics of vegetable production in India

**Suggested Reading**

- Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. *Vegetable crops*. Vols. I-III. Nayaudyog.
- Bose TK, Som MG and Kabir J. (Eds.). 1993. *Vegetable crops*. Naya prokash.
- Chadha KL and Kalloo G. (Eds.). 1993-94. *Advances in horticulture* Vols. V-X. Malhotra publ. house.
- Chadha KL. (Ed.). 2002. *Handbook of horticulture*. ICAR.
- Chauhan DVS. (Ed.). 1986. *Vegetable production in India*. Ramprasad and sons.
- Fageria MS, Choudhary BR and Dhaka RS. 2000. *Vegetable crops: production technology*. Vol. II. Kalyani.
- Gopalakrishnan TR. 2007. *Vegetable crops*. New India publ. agency.
- Hazra P and Banerjee MK and Chattopadhyay A. 2012. *Varieties of vegetable crops in India*, (Second edition), Kalyani publishers, Ludhiana, 199p.
- Hazra P. 2016. *Vegetable science*. 2<sup>nd</sup> edn, Kalyani publishers, Ludhiana.
- Hazra P. 2019. *Vegetable production and technology*. New India publishing agency, New Delhi.
- Hazra P, Chattopadhyay A, Karmakar K and Dutta S. 2011. *Modern technology for vegetable production*, New India publishing agency, New Delhi, 413p
- Rana MK. 2008. *Olericulture in India*. Kalyani Publishers, New Delhi.
- Rana MK. 2008. *Scientific cultivation of vegetables*. Kalyani Publishers, New Delhi.
- Rubatzky VE and Yamaguchi M. (Eds.). 1997. *World vegetables: principles, production and nutritive values*. Chapman and Hall.
- Saini GS. 2001. *A text book of oleria and floriculture*. Aman publishing house.
- Salunkhe DK and Kadam SS. (Ed.). 1998. *Handbook of vegetable science and technology: production, composition, storage and processing*. Marcel Dekker.
- Shanmugavelu KG., 1989. *Production technology of vegetable crops*. Oxford and IBH.



Singh DK. 2007. *Modern vegetable varieties and production technology*. International book distribution Co.

Singh SP. (Ed.). 1989. *Production technology of vegetable crops*. Agril. comm. res. centre. Thambur

aj S and Singh N. (Eds.). 2004. *Vegetables, tuber crops and spices*.

ICAR. Thompson HC and Kelly WC. (Eds.). 1978. *Vegetable crops*. Tata McGraw-Hill.

- **Course Title** : Basic concepts in laboratory techniques
- **Course Code** : PGS 509
- **Credit Hours** : 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 vacuumpets;
- 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, sand bath, water bath, oil bath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

#### Suggested Readings

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

#### I. Course Title : Information Technology in Agriculture

#### II. Course Code : MCA 510

#### III. Credit Hours : 1+1

#### IV. Need of the course

This is a course on Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of MS Office. Also to understand Internet and WWW, use of IT application and different IT tools in Agriculture

#### V. Theory

##### Unit I

Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions,



**Unit II**

Database, concepts and types, uses of DBMS in Agriculture, World Wide Web  
Statistical Sciences: Computer Application

**765**

(WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications,

**Unit III**

Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computercontrolled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.,

**Unit IV**

Geospatial technology for generating valuable agri-information. Decision support systems, concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting Farm decisions, Preparation of contingent crop-planning using IT tools.

**VI. Suggested Reading**

- Vanitha G. 2011. Agro-informatics
- <http://www.agrimoon.com>
- <http://www.agriinfo.in>
- <http://www.eagri.org>
- <http://www.agriglance.com>
- <http://agritech.tnau.ac>



## THIRD SEMESTER

- I. Course Title** :Principles and Practices of Water Management  
**II. Course Code** :AGR 511  
**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-water-plant 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 losses.

**Unit III**

Soil, plant and meteorological factors determining water needs of crops, scheduling, depth and method 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 16. 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 doubling infiltration meter

#### VII. Teaching methods/activities

Classroom teaching with A V aids, group discussion, assignment and field visit

#### 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. PH 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.



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

**II. Course Code** :AGR 512

**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 A/V 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 Dabodghao PM. 1972. Forage Crops of India. ICAR.
- Singh P and Srivastava AK. 1990. Forage Production Technology. IGFR, 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.

- **Course Title** :Growth and Development of Vegetable Crops
- **Course Code** :HOR513
- **Credit Hours** :(2+1)

- **Need of the course?**

In agriculture, the term plant growth and development is often substituted with crop growth and yield since agriculture is mainly concerned with crops and their economic products. Growth, which is irreversible quantitative increase in size, mass, and/or volume of a plant or its parts, occurs with an expenditure of metabolic energy. Plant development is an overall term, which refers to various changes that occur during its life cycle. In vegetable crops, development is a series of processes from the initiation of growth to death of a plant or its parts. Growth and development are sometimes used interchangeably in conversation, but in a botanical sense, they describe separate events in the organization of the mature plant body. The students of vegetable science need to have an understanding of growth and development of vegetable crops.

- **Objective of the course**

To teach the physiology of growth and development of vegetable crops

No. Block	Unit
<ul style="list-style-type: none"> <li>• Growth and development of</li> <li>2. Physiology of dormancy and germination</li> </ul>	1. Introduction and phytohormones vegetable crops <ul style="list-style-type: none"> <li>• Abiotic factors</li> <li>• Fruit physiology</li> <li>• Morphogenesis and tissue culture</li> </ul>

- **Theory**

**Unit I**

*Introduction and phytohormones—*

Definition of growth and development; Cellular structures and their functions; Physiology of phytohormones functioning/biosynthesis and mode of action; Growth analysis and its importance in vegetable production.

**Unit II**

*Physiology of dormancy and germination—*

Physiology of dormancy and germination of vegetable seeds, tubers and bulbs; Role of auxins, gibberellins, cytokinins and abscisic acid; Application of synthetic PGRs including plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, anti-transpirants, anti-auxin, ripening retardant and plant stimulants in vegetable crop production.

**Unit III**

*Abiotic factors—*

Impact of light, temperature, photoperiod, carbon dioxide, oxygen and other gases on growth, development of underground parts, flowering and sex expression in vegetable crops; Apical dominance.

**Unit IV**

*Fruit physiology—* Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission; fruit ripening and physiological changes associated with ripening.

## Unit V

*Morphogenesis and tissue culture*—Morphogenesis and tissue culture techniques in vegetable crops; Grafting techniques in different vegetable crops.

### • Practical

- Preparation of plant growth regulator's solutions and their application;
- Experiments in breaking and induction of dormancy by chemicals;
- Induction of parthenocarpy and fruit ripening;
- Application of plant growth substances for improving flower initiation, changing sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables;
- Growth analysis techniques in vegetable crops;
- Grafting techniques in tomato, brinjal, cucumber and sweet pepper.

### • Teaching Methods/Activities

- Classroom Lectures
- Assignment (written and speaking)
  
- Student presentation
- Hands on training of different procedure
- Group discussion

### • Learning outcome

After successful completion of this course, the students are expected to:

- Acquire knowledge about the growth and development of plants in vegetable crops
- Distinguish between primary and secondary growth in plant stems
- Understand how hormones affect the growth and development of vegetable crops

### • Suggested Reading

- Bleasdale JKA. 1984. *Plant physiology in relation to horticulture* (2<sup>nd</sup> Edition) MacMillan, Gupta US, Eds. 1978. *Crop physiology*. Oxford and IBH, New Delhi.
- Kalioo G. 2017. *Vegetable grafting: Principles and practices*. CAB International, Krishnamoorti HN. 1981. *Application of growth substances and their uses in agriculture*. Tata McGraw Hill, New Delhi.
- Leopold AC and Kriedemann PE. 1981. *Plant growth and development*, Tata McGraw-Hill, New Delhi.
- Peter KV and Hazra P. (Eds). 2012. *Handbook of vegetables*. Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
- Peter KV. (Eds). 2008. *Basics of horticulture*. New India publication agency, New Delhi. Rana MK. 2011. *Physio-biochemistry and Biotechnology of Vegetables*. New India Publishing Agency, Pritam Pura, New Delhi.
- Saini et al. (Eds.). 2001. *Laboratory manual of analytical techniques in horticulture*. Agrobios, Jodhpur.

**Course Title** : Technical writing and communications skills  
**Course Code** : PGS 514  
**Credit Hours** : 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, Phonetics 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 H 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.

**Course Title** : Agricultural research, research ethics and rural development programmes  
**Course Code** : PGS 515  
**Credit Hours** : 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

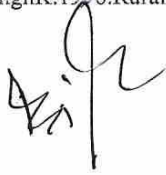
regional levels; International fellowships for scientific mobility.

**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.



# Fourth Semester

AGRON - 516      PRINCIPLES AND PRACTICES OF WEED MANAGEMENT      2+1

## Objective

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

## Theory

### UNIT I

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

### UNIT II

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

60

### 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.



- I. Course Title : Library and information services  
II. Course Code : PGS 517  
III. Credit Hours : (0+1)

**Objective**

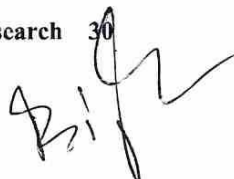
To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

**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.

**Seminar 0+1**

**Thesis Research 30**

A handwritten signature in black ink, appearing to be 'Bij', written over the text 'Thesis Research 30'.