

# **POST GRADUATE DEPARTMENT OF AGRICULTURE**

## **SYLLABUS FOR THE BATCH FROM THE YEAR 2022 TO YEAR 2024**

**Programme Code: MAGR**

**Programme Name: M.Sc. Ag. (Agronomy)**

**(Semester III- IV)**

**Examinations:2023-24**



## **Khalsa College, Amritsar**

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(b) Subject to change in the syllabi at any time.  
(c) Please visit the College website time to time**

## Program objectives:-

1. To acquaint students with field crops, water and soil management on a sustainable basis.
2. To acquaint students with the changing environment and adjust the production system accordingly.
3. To familiarize students with problems in the production system and their scientific solutions.
4. To familiarize students with the latest advance in the research and its application in crop production.

<b>M.SC. AG. (AGRONOMY)</b> <b>Program Specific Outcomes (PSOs) &amp; COURSE OUTCOMES (COs)</b>
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### PROGRAMME SPECIFIC OUTCOMES

<b>PSO-1</b>	To acquaint students with production technology i.e. sowing time, sowing method, seed treatment, nutrient management, weed management and water management of field crops.
<b>PSO-2</b>	To study recent updates in resource conservation. i.e. crop residue, water and soil, cropping and farming systems.
<b>PSO-3</b>	To acquire knowledge about the package of production for organic, sustainable, Integrated farming systems, precision farming and the certification of farm.
<b>PSO-4</b>	To understand biotic and abiotic stresses; dryland agriculture, moisture conservation techniques, water harvesting, climate change and the concept of ideal plant type
<b>PSO-5</b>	To understand the concepts of statistical methods and statistical inference that would help in understanding the importance of statistics. .
<b>PSO-6.</b>	To get knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.
<b>PSO-7</b>	To understand the characteristics of Indian monsoon, rainfall distribution, problematic soils and their management.
<b>PSO-8</b>	To familiarize students with the weeds, herbicides and methods of weed control.
<b>PSO-9</b>	To study crop husbandry of oilseed, pulses, fiber, sugar crops, fodder crops
<b>PSO-10</b>	To provide information about how to collect material related to research, how to write thesis, use scientific language in thesis, and publish the research papers in different journals.

**SEMESTER-I**

Course Code	Course Title	Credit hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
AGR-511	Modern Concepts in Crop Production	3(2+1)	50+25+25	100	6-7
AGR-512	Principles and Practices of Water Management	3(2+1)	50+25+25	100	8-9
SSC-410 (Minor)	Soil Chemistry and Bio Chemistry	3(2+1)	50+25+25	100	10-11
STA-414	Statistical Methods for Research Workers	3(2+1)	50+25+25	100	12-13
*PGS-501	Technical Writing & Communication Skills	1(1+0)	100 (Th)	100	14
*PGS-502	Library & Information Services	1(0+1)	100 (Pr)	100	15
*AGR-600	Masters' Research	4(0+4)	--	S/US	16
<b>Total</b>		<b>18(12+6*)</b>			

\* Non-credit course.

Total Internal Assessment = 25 marks (Mid Semester Test - 10; Attendance - 10; Conduct & Academic, Extra Curricular Activities - 5)

## SEMESTER-II

Course Code	Course Title	Credit hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
AGR- 521	Principles and Practices of Weed Management	3(2+1)	50+25+25	100	17-18
AGR- 522	Field Plot Techniques	3(2+1)	50+25+25	100	19-20
AGR-523 (Minor)	Agronomy of Fodder and Forage Crops	3(2+1)	50+25+25	100	21-22
STA-424	Experimental Designs for Research Worker	3(2+1)	50+25+25	100	23-24
*PGS-503	Agricultural Research, Publication Ethics	1(1+0)	100 (Th)	100	25-26
*AGR-600	Masters' Research	4(0+4)		S/US	27
<b>Total</b>		<b>17(12+5*)</b>			

\* Non-credit course.

Total Internal Assessment = 25 marks (Mid Semester Test - 10; Attendance - 10; Conduct & Academic, Extra Curricular Activities - 5)

### SEMESTER-III

Course Code	Course Title	Credit hours	Marks	Total Marks	Page Number
			Theory + Practical + I. Assessment		
AGR-531	Agronomy of Major Cereals and Pulses	3(2+1)	50+25+25	100	28-29
AGR-532	Principles and Practices of Organic Farming	3(2+1)	50+25+25	100	30-31
SSC-533/ AGM-533/	Fertilizer Technology/ Physiology of Growth and Development Fundamentals of Agroclimatology	3(2+1)	50+25+25	100	32-34
AGR-591	Credit Seminar	1(1+0)	100	100	35
*PGS-504	Intellectual Property & its Management in Agriculture	1(1+0)	100 (Th)	100	36-37
*AGR-600	Masters' Research	6(0+6)	--	S/US	38
<b>Total</b>		<b>17(10+7*)</b>			

\* Non-credit course.

Total Internal Assessment = 25 marks (Mid Semester Test - 10; Attendance - 10; Conduct & Academic, Extra Curricular Activities - 5)

### SEMESTER-IV

Course Code	Course Title	Credit hours	Marks	Total Marks	Page No
			Theory + Practical + I. Assessment		
AGR-541	Cropping Systems and Sustainable Agriculture	3(2+1)	50+25+25	100	39
AGR-542	Agronomy of Oilseed, Fibre and Sugar crops	3(2+1)	50+25+25	100	41
*PGS-505	Disaster Management	1(1+0)	100	100	41
*AGR-600	Masters' Research	6(0+6)	--	S/US	4
<b>Total</b>		<b>13(6+7*)</b>		<b>200</b>	

\* Non-credit course.

Total Internal Assessment = 25 marks (Mid Semester Test - 10; Attendance - 10; Conduct & Academic, Extra Curricular Activities - 5)

# SEMESTER-I

**AGR-511: Modern Concepts in Crop Production**

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 75**

**Internal assessment: 25**

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

## **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 15 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (15).

## **Course objectives:**

1. To study relationship of environmental factors with growth and development in crops.
2. To understand physiology of yield in relation to biotic and abiotic environment.
3. Basic concepts of crop Ideotypes for maximizing crop yield.
4. To know modern concepts in farming for efficient use of resources.

## **Theory**

**Section-A:** Crop growth analysis in relation to environment, agro-ecological zones of India. Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation its interpretation and applicability; Baule unit.

**Section-B:** 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.

**Section-C:** Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.

**Section-D:** 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.

## **Practical**

Analysis of Growth & Development; leaf area index, Crop Growth rate, Relative growth rate, etc; Estimation of yield, mulching, cropping scheme, crop rotation, comparison of chemical & organic farming; Quality standards for organic farming.

### VIII. Suggested Reading

- Balasubramaniyan 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*. 7thEd. 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.

#### Course outcomes:

**Course Title: Modern Concepts in Crop Production      Course Code: AGR-511**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Understand the advanced concepts of crop growth and productivity in relation to climate change.
CO2	Acquire knowledge on modern concepts in tillage and farm mechanization.
CO3	Gain knowledge on the principles and components of organic farming and resource conservation technology.
CO4	Gain knowledge on ideal plant ideotypes and yield maximization



## SEMESTER-I

**AGR-512: Principles and Practices of Water Management**

**Time: 3 Hours**  
**100**

**Maximum marks:**

**Theory: 50**  
**Practical: 25**  
**Internal assessment: 25**  
Credit hours: 3(2+1)

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### **Course objectives:**

- To study about the water resources of India
- To study about the different irrigation projects, soil water plant relationship
- To know about the water management crop and cropping systems and management of crops
- To know the effect of excess water on plant growth, drainage requirements of crop,

### **Theory**

**Section-A:** Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states. Soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition.

**Section-B:** Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; micro irrigation system; fertigation; management of water in controlled environments and polyhouses.

**Section-C:** Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency.

**Section-D:** Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing.

**Practical:** Measurement of soil water potential by using tensiometer, pressure plate and membrane apparatus; soil-moisture characteristics curves; water flow measurements using

different devices; determination of irrigation requirements; calculation of irrigation efficiency; determination of infiltration rate; determination of saturated? Unsaturated hydraulic conductivity.

### Suggested 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.

**Course Title: Principles and Practices of Water Management      Course Code: AGR-512**

Sr. No.	On completing the course, the students will be able to:
CO1	Understand the principles involved in estimating water requirements of different crops.
CO2	Gain knowledge on various methods of irrigation scheduling .
CO3	Acquire knowledge on pressurized irrigation systems to economize the use of water.
CO4	Construct ideologies pertaining to water management in problematic soils
CO5	Analyse the quality of irrigation water.

## SEMESTER-I

SSC-410

Soil Chemistry and Bio Chemistry (Minor)

Time: 3 Hours  
100

Max. Marks:

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours per week: 2+1

### Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### Course objectives:

- This course familiarize student with soil colloids, ion exchange phenomenon,
- To provide knowledge on organic matter and describe how to promote populations of beneficial soil organisms.
- Learn how soil health relates to the soil ecology and soil environment quality.
- Students will learn about problematic soils and their reclamations with reference to their distribution in different states of India.

### Theory

**Section-A:** Soil colloids–nature, properties, origin of charges and their significance; Cation and anion exchange phenomena and their importance; Introduction to ionic adsorption and fixation;

**Section-B:** Soil reaction and buffering; Distribution, characterization, genesis and amelioration of acid, acid sulphate, saline, saline-sodic, sodic and calcareous soils; Plant reaction and tolerance to soil salinity, sodicity and acidity;

**Section-C:** Chemical and electro chemical properties of submerged soils; Organic matter and characterization of clay –organic matter interaction ;

**Section-D:** Biochemical decomposition of organic manures and farm wastes, composting and vermicomposting .Biochemistry of humus formation and biogas production .

### Practical:

Determination of the effect of dilution and salinity on soil pH; Active and potential acidity; Cation and anion exchange capacity and exchangeable cations; Soluble salts in soils; Lime

and gypsum requirements. Nutrient adsorption and fixation capacities of soils; Estimation of biochemical constituents of organic residues- cellulose, hemi-cellulose, lignin and C: N ratio. Preparation of enriched compost, biofertilizers and vermiculture

**Suggested Reading**

- Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu
- Troeh FR and Thompson LM. 2005. *Soils and Soil Fertility*. Blackwell.
  
- Bear RE. 1964. *Chemistry of the Soil*. Oxford and IBH.
- Bolt GH & Bruggenwert MGM. 1978. *Soil Chemistry*. Elsevier.
- Greenland DJ & Hayes MHB. 1981. *Chemistry of Soil Processes*. John Wiley & Sons.
- Greenland DJ & Hayes MHB. *Chemistry of Soil Constituents*. John Wiley & Sons.
- McBride MB. 1994. *Environmental Chemistry of Soils*. Oxford Univ. Press.
- Sposito G. 1981. *The Thermodynamics of Soil Solutions*. Oxford Univ. Press.
- Sposito G. 1984. *The Surface Chemistry of Soils*. Oxford Univ. Press.
- Sposito G. 1989. *The Chemistry of Soils*. Oxford Univ. Press.
- nd
- Stevenson FJ. 1994. *Humus Chemistry*. 2 Ed. John Wiley & Sons.
- Van Olphan H. 1977. *Introduction to Clay Colloid Chemistry*. John Wiley & Sons.

**Course outcomes:**

CO1	Students will know about soil colloids, cation exchange & Anion exchange phenomena, con adsorption and Fixation.
CO2	Soil reaction & Buffering, distribution, genesis and amelioration of different problematic soil & their effects on Plant growth.
CO3	Chemical and affection chemical properties of submerged soils; Biochemical decomposition of organic manures.

## SEMESTER-I

**STA-414: Statistical Methods for Research Workers**

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

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

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

**Course Objectives:** The aim of this course is to understand the basics of statistical methods and their applications in agriculture. It helps the students in understanding, analyzing and interpreting the agricultural data. It also helps in making appropriate decisions in agricultural research findings.

### **Theory**

**Section-A:** Probability and fitting of standard frequency distribution, sampling techniques, sampling distributions, mean and standard error.

**Section-B:** Simple partial, multiple and intra- class correlation and multiple regression.

**Section-C:** Tests of significance, students'-t, chi-square and large sample tests, confidence intervals.

**Section-D:** Analysis of variance for one way and two way classification with equal cell frequencies, transformation of data.

### **Practical:**

Fitting of distributions, samples and sampling distributions, correlation and regression, tests of significance and analysis of variance.

**Note:** Students shall be trained to use computer to analysis the data, using available softwares. However, during university examination students will use scientific calculators to analyse the data.

### **Suggested Reading:**

1. Goon A.M, Gupta M.K and Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I. The World Press.
2. Goon A.M, Gupta M.K. and Dasgupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.
3. Hoel P.G. 1971. Introduction to Mathematical Statistics. John Wiley.
4. Hogg R.V and Craig T.T. 1978. Introduction to Mathematical Statistics. Macmillan.
5. Morrison D.F. 1976. Multivariate Statistical Methods. McGraw Hill.
6. Hogg RV, McKean JW, Craig AT. 2012. Introduction to Mathematical Statistics 7th Edition.
7. Siegel S, Johan N & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley.
8. Anderson TW. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Ed. John Wiley
9. <http://freeststatistics.altervista.org/en/learning.php>.
10. <http://www.statsoft.com/textbook/stathome.html>.

**Course Title: Statistical Methods for Research Workers      Course Code: STA-414**

Sr. No.	On completing the course, the students will be able to:
CO1	Understand the concept of probability, sampling techniques, standard error etc.
CO2	Apply correction and regression techniques.
CO3	Know the use of T-Test, chi-square and large sample tests

**Time: 3 Hours**  
**100****Maximum marks:****Practical: 100**  
**Credit hours:****1(0+1)****Instructions for the Paper Setters:**

1. The question paper will consist of nine skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible. The answer should be in 50-80 words. (5×8=40 Marks)
3. There will be four essay type questions carry 15 marks from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words. (4×15= 60 Marks)

**Course Objective:** To equip the students with skills and techniques to write dissertations, research papers, review paper, book chapter and articles etc. To equip the students with skills to communicate and articulate in English and scientific language (verbal as well as writing).

**Practical:**

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 Reading:**

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.

**Course Title: Technical writing & communication skills , library & information services**  
**Course Code: PGS-501**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Understand the basic components like definitions, descriptions, process explanations and other common forms of technical writing
CO2	Understand how to follow the stages of the writing process and apply them to technical and workplace writing tasks
CO3	Synthesize material collected from primary and secondary sources with their own ideas while writing research papers



## SEMESTER-I

\*PGS 502

Library and Information Services

Time: 3 Hours  
100

Maximum marks:

Practical: 100  
Credit hours:

1(0+1)

### Instructions for the Paper Setters:

1. The question paper will consist of nine skill-oriented questions.
2. The first 5 questions carry 8 marks each. There will be internal choice wherever possible. The answer should be in 50-80 words. (5×8=40 Marks)
3. There will be four essay type questions carry 15 marks from the entire syllabus. There will be internal choice wherever possible. The answer should be in 250 words (4×15= 60 Marks)

**Course objectives :** 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, Stat software, 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.

### Course Outcome:

#### The student will be able to:

Sr.No.	On completing the course, the students will be able to:
CO1	Understand the library services and its benefit in research work
CO2	Understand how to follow the stages of the writing process along with material available at library resources
CO3	To understand the library services available at desired institute

## **SEMESTER-I**

**\*AGR-600 Master's Research**

**S/US  
Credit hours: 04**

## SEMESTER-II

**AGR-521: Principles and Practices of Weed Management**

**Time: 3 Hours**

**Maximum marks:**

**100**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

Credit hours per week: 3(2+1)

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### **Course objectives:**

- To understand importance of weed biology and weed ecology in weed management.
- Classification of weeds, different methods of weed control and weed indices
- Classification of herbicide, formulations, mixtures, resistance and its management
- To understand concept of Integrated weed management bio-herbicides, mycoherbicides and allelopathy in weed management
- Weed management in different crops and their economic study.

### **Theory:**

**Section-A:** Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification classification management; weed indices, weed shift in different eco-systems

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

**Section-C:** 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.

**Section-D:** 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. Integrated weed management; recent development in weed management- robotics, use of drones and aeroplanes, organic etc., 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, 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

### **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.*

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Get knowledge on weed biology and survey weeds in varied ecosystem.
CO2	Identify the nature, types and economic uses of weeds in varied habitats.
CO3	Gain knowledge on herbicide application techniques
CO4	Formulate integrated weed management practices for different ecosystems

## SEMESTER-II

**AGR-522: Field Plot Techniques**

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

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

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### **Course objectives:**

- To acquaint about planning, selection of treatments, experimental design, selection of site for field experiments and precautions in experimentation
- Conduct of experiment, layout, assigning treatments, recording observations, compiling data, analysis of data and interpretation

### **Theory**

**Section-A:** Planning field experiments - objectives, selection of field and treatment. Conduct of the experiment, precautions during sowing management, harvesting and threshing - Sampling. **Section-B:** Recording biometrical observations. Source of error in the field experiments and methods of reducing it. Optimum plot size and number of replications.

**Section-C:** Selection of experimental designs. Rotational experiments. Experiments to study the effect of years and locations compilation, presentation and interpretation of the data.

**Section-D:** Factorial experiments and interaction effects. Different tests of significance. Correlation and response functions. Transformation of data.

### **Practical:**

Actual layout of field experiments. Critical examination of experiments scientific journals. Compilation and interpretation of the given data. Missing lots and analysis of variance results. Use of computers for analysis

## Suggested Reading

- Gomez, K.A. and Gomez, A.A., 1984. Statistical procedures for agricultural research. John wiley & sons.
- 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.

**Course Title: Field Plot Techniques  
522**

**Course Code: AGR-**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Learn about the planning of field experiments.
CO2	Conduct and record observations by various experimental designs and draw inferences.

## SEMESTER-II

**AGR-523                      Agronomy of Fodder and Forage Crops (Minor)**

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

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

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### **Course objectives:**

- To study about the adaptation, distribution, agro techniques, anti-quality factors and improvement of fodder crops
- To study about the preservation and utilization of forage and pasture crops
- To know about the economics of forage cultivation, grassland of India and their improvement
- To know about the principles of grassland ecology, economic aspect of grassland, problems and their management

### **Theory:**

**Section-A:** Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like maize, bajra, guar, cowpea, oats, barley, berseem, senji, lucerne etc. and forage crops like, napier grass, panicum, lasiuras, cenchrus etc.

**Section-B:** Year-round fodder production and management, preservation and utilization of forage and pasture crops. Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage.

**Section-C:** Use of physical and chemical enrichments and biological methods for improving nutrition.

**Section-D:** Value addition of poor quality fodder. Economics of forage cultivation uses and seed production techniques.



**Practical:** Farm operations in raising fodder crops; Canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose 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

**Suggested Readings**

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

**Course Title: Agronomy of Fodder and Forage crops**

**Course Code: AGR-**

**523**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Study about the adaptation, distribution, agro techniques, anti-quality factors for the improvement of fodder crops
CO2	Know about the use of physical and chemical enrichment and biological methods for the improvement in nutrition

## SEMESTER-II

**STA-424: Experimental Designs for Research Workers**

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

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

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

**Course Objectives:** The aim of this course is to understand the basics of statistical methods and their applications in agriculture. It helps the students in understanding, analyzing and interpreting the agricultural data. It also helps in making appropriate decisions in agricultural research findings.

### **Theory:**

**Section-A:** Need for designing of experiments- characteristics of a good design, basic principles- randomization, replication and local control, uniformity trials- size and shape of plots and blocks, analysis of variance and interpretation of data.

**Section-B:** Completely randomized, randomized block and latin square design, multiple comparison tests, factorial experiments- interpretation of main effects and interactions,

**Section-C:** Orthogonality and partitioning of degrees of freedom confounding in  $2^3$ ,  $2^4$  and  $3^3$  designs, split and strip plot designs, crossover designs and balanced incomplete block designs, response surface designs, switch over trials and long term experiments;

**Section-D:** Selection of experimental design, mechanical errors in field experiments and methods of reducing it, presentation of research results.

### **Practical:**

Uniformity trials, completely randomized, randomized block and latin square designs, missing plot and analysis, of covariance,  $2^3$ ,  $2^4$  and  $3^3$  simple and confounded experiments, split and strip plot designs, cross over Uniformity trials, completely randomized, randomized block and latin square designs, missing plot and

analysis, of covariance,  $2^3$ ,  $2^4$  and  $3^3$  simple and confounded experiments, split and strip plot designs, cross over and balanced incomplete block designs.

**Note:** Students shall be trained to use computer to analysis the data, using available softwares. However, during university examination students are allowed to use scientific calculators to analysis is the data.

**Note:** Students are allowed to use scientific calculator in University examinations; statistical tables will be provided to students in examinations. No rigorous mathematical proofs are expected from students; stress will be on application only.

**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).

**Course Title: Experimental Designs for Research Workers      Course Code: STA-424**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Get knowledge on the designs, their principles, analysis of variance and interpretation of data.
CO2	Study various mechanical errors in field experiments, methods of reducing them and presentation of research results.

## SEMESTER-II

### \*PGS-503 - Agricultural Research & Publication Ethics

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 100**

**Credit hours: 1 (1+0)**

#### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

**Course Objectives:** The aim of this course is to understand the moral judgment and reactions. Identify the publication misconduct, scientific misconduct, complaints and appeals.

#### **Theory:**

**Section A:** Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgments and reactions.

**Section B:** Publication ethics: definition, introduction and importance. Best practices/standards setting initiative and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, type.

**Section C:** Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals. Ethics with respect to science and research. Intellectual honesty and research integrity.

**Section D:** Scientific misconduct: Falsification, Fabrication, and Plagiarism (FFP); Redundant publication: duplicate and overlapping publication, salami slicing; selective reporting and misrepresentation of data.

#### **Suggested Readings:**

- Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
- Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.

- Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
- Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

**Course Title: Agricultural research and publication ethics      Course Code: PGS-503**

Sr.No.	On completing the course, the students will be able to:
CO1	Understand the moral judgment and reactions
CO2	Identify the publication misconduct, scientific misconduct, complaints and appeals

## **SEMESTER-II**

**\*AGR-600**

**Master's Research**

**S/US**

**Credit hours: 04**

## SEMESTER-III

**AGR-531: Agronomy of Major Cereals and Pulses**

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

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

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### **Course objective:**

- To know about the origin, history, growing areas, climatic requirement, family/sub family, morphology, physiology of cereals and pulses
- To study about the phenology, improved varieties, cropping systems and production technology of cereals and pulses at regional and national level
- To know about post-harvest handling, the quality components and industrial use of the main and by products

### **Theory:**

Origin, 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:

**Section-A:** *Kharif* cereals

**Section-B:** *Rabi* cereals

**Section-C:** *Kharif* pulses

**Section-D:** *Rabi* pulses

### **Practical:**

Phenological studies at different growth stages of crop • Estimation of crop yield on the basis of yield attributes. Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities. Working out growth indices (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.

**Suggested Reading:**

- 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 FieldCrops. Oxford & IBH.
- Singh SS. 1998. Crop Management. Kalyani. • Yadav DS. 1992. Pulse Crops. Kalyani.

**Course Title: Agronomy of Major Cereals and Pulses**  
**531**

**Course Code: AGR-**

Sr. No.	On completing the course, the students will be able to:
CO1	Get knowledge on the staple food crops and their cultivation practices with post harvest technologies
CO2	Assess the nature of the farm site and develop a new cropping system with the available resources
CO3	Understand recent crop management practices on crop productivity and resource use efficiency.
CO4	Gain knowledge on the recent trends in the cultivation of crops
CO5	Develop post harvest management practices and value addition.



## SEMESTER-III

AGR-532

Principles and Practices of Organic Farming

Time: 3 Hours

Maximum marks: 100

Theory: 50

Practical: 25

Internal assessment: 25

Credit hours: 3(2+1)

### Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (10).

### Course objective:

- Knowledge and concept of organic farming
- Basics of soil fertility, nutrient cycle manures and soil biota
- Knowledge of weeds and their control in agricultural crops
- Basic concepts of marketing and export potential, certification and labelling
- Study of cropping and farming systems for sustainable agriculture

### Theory:

**Section-A:** Organic farming - concept and definition, its relevance to India and global agriculture and future prospects;

**Section-B:** land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro forestry. Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

**Section-C:** Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity. Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

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

### Practical:

Aerobic and anaerobic methods of making compost; making of vermicompost; identification and nursery raising of important agro forestry trees and trees for shelter belts;

efficient use of biofertilizers, technique of treating legume seeds with rhizobium cultures, use of azotobacter, azospirillum, and PSB cultures in field; visit to an organic farm; quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms.

**Suggested Reading:**

1. Ananthkrishnan TN. (Ed.). 1992. Emerging Trends in Biological Control of Phytophagous Insects. Oxford & IBH.
2. Gaur AC. 1982. A Manual of Rural Composting, FAO/UNDP Regional Project Document, FAO.
3. Joshi M. 2016. New Vistas of Organic Farming. Scientific Publishers
4. Lampin N. 1990. Organic Farming. Press Books, Ipswich, UK.
5. Palaniappan SP and Anandurai K. 1999. Organic Farming – Theory and Practice. Scientific Publ.
6. Rao BV Venkata. 1995. Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective: Publ.3, Parisaraprajna Parishtana, Bangalore.
7. Reddy MV. (Ed.). 1995. Soil Organisms and Litter Decomposition in the Tropics. Oxford & IBH.
8. Sharma A. 2002. Hand Book of Organic Farming. Agrobios.
9. Singh SP. (Ed.). 1994. Technology for Production of Natural Enemies. PDBC, Bangalore.
10. Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.
11. Trivedi RN. 1993. A Text Book of Environmental Sciences, Anmol Publ.
12. Veeresh GK, Shivashankar K and Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture. Association for Promotion of Organic Farming, Bangalore.
13. WHO. 1990. Public Health Impact of Pesticides Used in Agriculture. WHO.
14. Woolmer PL and Swift MJ. 1994. The Biological Management of Tropical Soil Fertility. TSBF & Wiley

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

**Course Code: AGR-532**

Sr. No.	On completing the course, the students will be able to:
CO1	Acquire knowledge on the concepts of organic agriculture.
CO2	Get information about the impact of organic farming and indigenous practices on the environment.
CO3	Understand the procedure followed for organic certification

## SEMESTER-III

SSC-533

Fertilizer Technology (Minor)

**Time: 3 Hours**

**100**

**Maximum marks:**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

Credit hours: 3(2+1)

### Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### Course objectives:

- To impart knowledge about fertilizers, their manufacturing processes.
- This course also provide knowledge on classification of fertilizers, their properties and use.

### Theory:

**Section-A:** Fertilizer industry in India; Raw materials; Manufacture of different types of fertilizers including reactions and flow diagrams;

**Section-B:** Granulation, segregation, caking, drying and cooling of fertilizers;

**Section-C:** Complex, mixed, liquid, suspension and slow release fertilizers;

**Section-D:** Production of fertilizers containing secondary and micronutrients; changing trends in fertilizer technology.

### Practical:

Collection of soil and fertilizer samples; Preparation of standard solutions. Colorimetric and flame photometric methods; Analysis of soil for fertilizer recommendations and suitability for orchard plantation; Gypsum and lime requirements of soil; Analysis of fertilizer for quality control; Planning and formulation of project on establishment of soil and fertilizer testing laboratories. Visit to fertilizer factories.

### Suggested Reading

- Brady NC and Weil RR. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu
- Troeh FR and Thompson LM. 2005. *Soils and Soil Fertility*. Blackwell.

**Course Title: Fertilizer Technology (Minor)**

**Course Code: SSC-533**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Know about fertilizer Industries, manufacturing of different type of fertilizers and changing trends in fertilizers technology.
CO2	Know recent changing trends in fertilizers technology.

## SEMESTER-III

**BOT-533**

**Physiology of Growth and Development**

**Time: 3 Hours**

**Maximum marks: 100**

**Theory: 50**

**Practical: 25**

**Internal assessment: 25**

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

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### **Course objectives:**

To study the physiological processes occurring in the plants.

To study the growth promoting and growth inhibiting substances their role in agriculture

To study the role of plant physiology in agriculture.

### **Theory:**

Concepts of growth, differentiation and pattern formation; growth curves, meristems, growth kinetics, factors affecting growth and general aspects of development, level of differentiation, control of development at genetic level. Hormones and growth regulators - auxins, gibberellins, cytokinins, ethylene, ABA, other inhibitors, retardants, polyamines, aliphatic alcohols, brassins, hormonal regulation of growth and development, plant movements; photoperiodism, phytochrome, flowering hormones, vernalization, abscission, ageing, senescence; physiology of seed and fruit development; seed germination; seed and bud dormancy. Plant physiology and agriculture.

### **Practical:**

Experiments on growth measurements, hormonal bioassays, plant movements; experiments on quality of light on seed germination, breaking of dormancy. Experiments on photoperiodism. Experiments on hormonal regulation of development.

**Course Title: Physiology of growth and development      Course Code: BOT-533**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Know the growth and physiological processes in plants
CO2	Use different growth substances in crop production
CO3	Use growth retardants for yield enhancement.

## SEMESTER-III

AGM-533

Fundamentals of Agroclimatology (Minor)

Time: 3 Hours  
100

Maximum marks:

Theory: 50  
Practical: 25  
Internal assessment: 25  
Credit hours: 3(2+1)

### Instructions for the Paper Setters:

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### Course objectives:

- To understand the concepts and nature of atmosphere as well as solar radiations
- To study the different meteorological variables and their impact on plants as well as animals.
- To understand the phenomena of general circulation of earth.

### Theory:

**Section-A:** Survey of the atmosphere; introduction to basic meteorological processes; nature, receipt and disposal of solar radiation;

**Section-B:** Atmospheric humidity and forms condensation; Evaporation and evapotranspiration; Winds, air masses and disturbance;

**Section-C:** Influence of climate on plants, animals and pests; Meteorological droughts; indices in agroclimatology;

**Section-D:** Agroclimatic classifications and their application; field climate modification.

### Practical:

Meteorological instruments and their use in the measurement of agroclimatic environment; Measurement of field climate; Computation of agroclimatic indices-GDD, PTU, PET etc; Determining crop production sensitivity to weather.

**Suggested Reading**

- Bishnoi OP. 2007. *Principles of Agricultural Meteorology*. Oxford Book Co.
- Kakde JR. 1985. *Agricultural Climatology*. Metropolitan Book Co.
- Mahi and Kingra. 2014. *Fundamentals of agrometeorology*. Kalyani publishers.
- Mavi HS and Tupper. 2004. *Principles and applications of climate studies in agriculture*. CRC Press
- Varshneya MC and Pillai PB. 2003. *Text Book of Agricultural Meteorology*. ICAR.

**Course Title: Fundamentals of Agroclimatology****Course Code: AGM 533**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Acquire knowledge on agro meteorology and its different variables affecting crop production
CO2	Understand the concept of onset and withdrawal of monsoon in relation to crop production
CO3	Gain knowledge on evapotranspiration and its effect on crop production
CO4	Understand weather forecasting and the impact of weather in relation to pest and disease management
CO5	Design crop weather calendar for various agro climatic zones

## **SEMESTER-III**

**AGR-591**

**CREDIT SEMINAR**

**Total Marks: 100**  
**Credits per week: 1(1+0)**



## SEMESTER-III

**\*PGS-504**

### **Intellectual Property & its Management in Agriculture**

**Time: 3 Hours**  
**100**

**Maximum marks:**

**Theory: 100**

**Credit hours: 1 (1+0)**

#### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
4. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

#### **Course objectives:**

- To equip students with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance
- Use of IPR as a tool for wealth and value creation in a knowledge based economy.

#### **Theory:**

**Section A:** 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.

**Section B:** 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.

**Section C:** Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity.

**Section D:** 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.

**Course Title: Intellectual Property & its Management in Agriculture**  
**Course Code: PGS 504**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	The students will have acquaintance of intellectual property rights
CO2	Will have knowledge of National and international laws on biodiversity and sustainable use of plant genetic resources through transfer and sharing.
CO3	Can assist in follow up of various treatises and laws for research collaborations at international levels.

## **SEMESTER-III**

**\*AGR-599**

**Masters' Research**

**S/US**

**Credits hours: 6(0+6)**

## SEMESTER-IV

**AGR-541: Cropping Systems and Sustainable Agriculture**

**Time: 3 Hours**

**100**

**Maximum marks:**

**Theory: 75**

**Internal assessment =25**

**Credit hours per week: 3(3+0)**

### **Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which first question of 10 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (10).

### **Course objectives:**

- To impart knowledge to the students on the fundamentals of farming systems and sustainable agriculture
- To study the various components of organic agriculture

### **Theory**

**Section-A:** Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use. Concept of sustainability in cropping systems and farming systems, scope and objectives;

**Section-B:** Production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems. Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping,

**Section-C:** Role of non-monetary inputs and low cost technologies; research need on sustainable agriculture. Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management;

**Section-D:** fertilizer use efficiency and concept of fertilizer use in intensive cropping system. Plant ideotypes for drylands; plant growth regulators and their role in sustainability. Artificial Intelligence- Concept and application.

### **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.

**Course Title: Cropping Systems and Sustainable Agriculture      Course Code: AGR-541**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Prepare cropping schemes, evaluate cropping system and workout input requirements for crops.
CO2	Understand interaction between different farm enterprises.
CO3	Prepare integrated farming system models for different eco systems.
CO4	Gain knowledge about drought mitigation strategies
CO5	Evaluate different resource management techniques in the conservation agriculture.

**AGR-542: Agronomy of Oil Seeds, Fibre and Sugar Crops**

**Time: 3 Hours**  
**100**

**Maximum marks:**

**Theory: 50**  
**Practical: 25**  
**Internal assessment =25**  
Credit hours per week: 2+1

**Instructions for the Paper Setters:**

1. Question paper should be set strictly according to the syllabus.
2. The language of questions should be straight & simple.
3. In all nine questions should be asked, of which the first question of 15 marks (Comprising of 10 short answer type questions covering the whole syllabus) will be compulsory.
4. Of the remaining eight questions, two questions should be asked from each section, of which the candidates are required to attempt one question from each section. All questions carry equal marks (15).

**Course objectives:**

- To impart knowledge about origin, history, area and production, classification of *Rabi* and *Kharif* crops oil Seeds, Fibre and Sugar Crops
- To study the agronomic practices of Rabi, Kharif, fiber, oil seed and sugar crops.

**Theory:**

Origin, 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 Rabi, oilseeds –

**Section-A:** *Rabi* Oilseeds-Rapeseed and mustard, linseed.

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

**Section-C:** Fiber Crops-Cotton, jute, sunhemp etc.

**Section-D:** Sugar crops – Sugar-beet and sugarcane.

**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

### **Suggested Reading**

- Das NR. 2007. Introduction to Crops of India. Scientific Publ.
- Das PC. 1997. Oilseed Crops of India. Kalyani.
- Lakshmikantam N. 1983. Technology in Sugarcane Growing. 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.

**Course Title: Agronomy of Oil Seeds, Fibre and Sugar Crops Course Code: AGR-542**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Study the different growth stages of crops and their intercultural operations.
CO2	Estimation of crop yield on the basis of yield attributes.
CO3	Working out cost of cultivation of different crops
CO4	Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities

## SEMESTER-IV

**\*PGS-505**

**Disaster Management**

**Time: 3 Hours  
100**

**Maximum marks:**

**Theory:**

**100**

**Credit hours:**

**1(1+0)**

### **Instructions for the Paper Setters:**

5. Question paper should be set strictly according to the syllabus.
6. The language of questions should be straight & simple.
7. There will be total of five questions, out of which first question of 20 marks (Comprising of 10 short answer type questions of 2 mark each) covering the whole syllabus will be compulsory.
8. Out of remaining eight questions, two questions should be asked from each section, out of which the candidates are required to attempt one question from each section. All question will carry equal marks (20).

### **Course objectives:**

- To impart knowledge about natural and man-made disasters.
- To impart knowledge about different management strategies during disasters

### **Section-A: Definition and types of disaster**

Hazards and Disasters, Risk and Vulnerability in disasters, Natural and Man-made disasters, earthquakes, floods drought, landslide, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

### **Section-B: Study of Important disasters**

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landslides and its managements case studies of disasters in Sikkim (e.g. Earthquakes, Landslide). Social, Economics and Environmental impact of disasters.



### **Section-C: Mitigation and Management techniques of disasters**

Basic principles of disaster management, Disaster Management cycle, Disaster Management policy, National and State bodies for disaster management, Early Warning Systems, Building design and construction in highly seismic zones, retrofitting of buildings.

### **Section-D: Training, awareness program and project on disaster management**

Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

**Course Title: Disaster Management**

**Course Code: PGS-505**

<b>Sr. No.</b>	<b>On completing the course, the students will be able to:</b>
CO1	Study the different hazards, disasters, risk and vulnerability during disasters,
CO2	mitigation and management techniques of different natural and man made hazards
CO3	training and awareness programs to control the risk of different kind of hazards
CO4	use of remote sensing tools for risk assessments and preparedness

## **SEMESTER-IV**

**\*AGR-600**

**\*Masters' Research**

**S/US**

**Credits hours: 6(0+6)**

