

New and Restructured Syllabus M.Sc. (Ag.) Agronomy

(Implement from Academic Session 2026-27)



**School of Agriculture and Allied Science
HNB Garhwal University
(A Central University)
Srinagar-Garhwal**

Preamble

The present syllabus of M.Sc. (Ag.) Agronomy has been designed in accordance with contemporary academic needs, emerging developments in agricultural science, and the changing demands of sustainable crop production systems. The programme aims to provide students with advanced knowledge, practical skills, and research competence in agronomy, with a special emphasis on crop production, soil fertility, water management, weed management, conservation agriculture, organic farming, dryland agriculture, and sustainable farming systems.

This revised and restructured syllabus, implemented from the Academic Session 2026–27, has been prepared to strengthen the scientific foundation of postgraduate education while ensuring its relevance to current agricultural challenges, including climate change, natural resource degradation, food and nutritional security, and the need for precision and environmentally friendly farming technologies. The curriculum integrates core theoretical understanding with practical training, field exposure, seminar presentation, experimental design, data analysis, and research-based learning.

The programme is intended to develop competent professionals, researchers, academicians, and extension workers who can address real-world agronomic problems through scientific reasoning, innovation, and field-oriented approaches. It also seeks to enhance students' capacity in technical writing, communication, research ethics, awareness of intellectual property, and the application of modern tools such as GIS, GPS, remote sensing, hydroponics, aeroponics, robotics, and artificial intelligence in agriculture.

The structure of the syllabus includes major, supporting, minor, and common courses, along with seminar, thesis, or project work, so as to ensure holistic academic growth and interdisciplinary understanding. Care has been taken to make the curriculum learner-centred, outcome-based, and aligned with national priorities in higher agricultural education.

It is expected that this syllabus will not only promote academic excellence but also prepare skilled human resources capable of supporting sustainable agricultural development, improving farm productivity, **and responding effectively to the needs of farmers, researchers, and society at large.**

Qualification: Bachelor's degree from a recognised University in B.Sc. (Hon.)/B.Sc. Agriculture /Horticulture in (10+2+4 yrs.) System with an aggregate of not less than 45% marks.

**New and Restructured Syllabus
M.Sc. (Ag.) Agronomy
Implemented from Academic Session 2026-27**

First Semester

Course Code	Course Title	Credits (Th. + P./Inter.)	Marks
Major			
SOA/AGRON/C-101*	Modern Concepts in Crop Production	3(3+0)	60+40
SOA/AGRON/C-102*	Principles and practices of Soil Fertility and Nutrient Management	3(2+1)	60+40
SOA/AGRON/C-103 *	Principles and Practices of Weed Management	3(2+1)	60+40
SOA/AGRON/C-104*	Principles and Practices of Water Management	3(2+1)	60+40
Supporting			
SOA/AGRON/SC-101	Statistical Methods for Applied Sciences	3(2+1)	60+40
Common			
SOA/AGRON/CC-101	Technical Writing and Communication Skills	1(0+1)	60+40
SOA/AGRON/CC-102	Basic Concept in Laboratory Techniques	1(0+1)	60+40
SOA/AGRON/CC-103	Intellectual Property and its management in Agriculture	1 (1+0)	60+40

- Compulsory courses

Second Semester

Course Code	Course Title	Credits (Th. + P./Inter.)	Marks
Major			
SOA/AGRON/C-105	Conservation Agriculture	2(1+1)	60+40
SOA/AGRON/C-106	Agronomy of Major Cereals and Pulses	3(2+1)	60+40
Minor			
SOA/AGRON/MC-101	Management of Problem Soils and Waters	3(2+1)	60+40
SOA/AGRON/MC-102	Soil Erosion and Conservation	2(2+0)	60+40
SOA/AGRON/MC-103	Principles of Plant Physiology I: Plant Water Relations and Mineral Nutrition	3(2+1)	60+40
Common			
SOA/AGRON/CC-104	Library and Information Services	1(1+0)	60+40
SOA/AGRON/CC-105	Agricultural Research Ethics and Rural Development Programme	1(1+0)	60+40
Supporting			
SOA/AGRON/SC-102	Experimental Designs	3(2+1)	60+40
Thesis	Research Planning and Review	5 (0+5)	Deferred

Third Semester

Course Code	Course Title	Credits (Th. + P./Inter.)	Marks
SOA/AGRON/C-107	Agronomy of Oilseed, Fibre and Sugar crops	3(2+1)	60+40
SOA/AGRON/S-101	Master's Seminar	1(0+1)	100
	Thesis (Research, execution and lab analysis)	10 (0+10)	Deferred

Fourth Semester

Course Code	Course Title	Credits (Th. + P./Inter.)	Marks
SOA/AGRON /C-114	Thesis (Execution, Data collection, Lab analysis, interpretation, and documentation) (Thesis must be signed by the Supervisor and having plagiarism certified by the student. Thesis must be checked by the external examiner and viva voce/presentation conducted)	15	100
OR			
SOA/AGRON /C-115	Project Based on seed production of Crops / farmer Field Survey (Projects must be evaluated and viva voce conducted by the external examiners appointed by the University)	15	100

Total Credits: 70**Summary of Courses**

Types of Courses	Credits
Major	20
Minor	08
Supporting	06
Common	05
Seminar	01
Thesis or Project	30
Total	70

Note: In case of any syllabus anomalies, the ICAR syllabus will be final.

Semester: I

Compulsory Courses

SOA/AGRON/C-101	Modern Concepts in Crop Production	3(3+0)	60+40
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Objective: To teach the basic concepts of soil management and crop production.

Course Outcome: Develop an understanding of India's agro-climatic regions, crop growth in relation to the environment, production requirements, crop modelling, response functions, and modern sustainable farming practices.

Theory

Unit I: Crop growth analysis in relation to the environment; geo-ecological zones of India.

Unit II: Quantitative agro-biological principles and the 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; optimisation of plant population and planting geometry in relation to different resources; concept of ideal plant type; and crop modelling 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 under stressed conditions.

Unit V: Integrated farming systems, organic farming, and resource conservation technology, including the modern concept of tillage; dry farming; determining the nutrient needs for the yield potential of crop plants; concept of balanced nutrition and integrated nutrient management; precision agriculture; modern crop production concepts such as soilless cultivation, aeroponics, hydroponics, robotics, and terrace farming; and the use of GIS, GPS, and remote sensing in modern agriculture, precision farming, and protected agriculture.

Teaching Methods/Activities: Classroom teaching with AV aids, group discussions, assignments, and class discussions.

Learning Outcome: Basic knowledge of soil management and crop production.

Suggested Reading: Balasubramaniyan, P., and Palaniappan, S.P. 2001. Principles and Practices of Agronomy. Agrobios. Fageria, N.K. 1992. Maximizing Crop Yields. Marcel Dekker. Havlin, J.L., Beaton, J.D., Tisdale, S.L., and Nelson, W.L. 2006. Soil Fertility and Fertilizers. 7th ed. d. 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, Now 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.

SOA/AGRON/C-102*	Principles and practices of Soil Fertility and Nutrient Management	3(2+1)	60+40
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Objective: To impart knowledge of soil fertility management, methods of evaluation, different manures and fertilizers used in crop production, and concepts of nutrient management.

Course Outcome: Gain an understanding of soil fertility and productivity, functions of essential nutrients and deficiency symptoms, organic manures and biofertilizers and their composition, fertilizers and their efficiency in crop production, and the timing and methods of manure and fertilizer application.

Theory

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

UNIT II Criteria of essentiality of nutrients; essential plant nutrients and 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 aspects; fertilizer mixtures and grades; methods of increasing fertilizer use efficiency; nutrient interactions.

UNIT V Time and methods of manure and fertilizer application; concept of foliar application; relative performance of organic and inorganic nutrients; economics of fertilizer use; integrated nutrient management; use of vermicompost and residue wastes in crops.

Practical Determination of soil pH, EC, organic C, available N, P, K, and S; total N in soil; total N, P, K, and S in plant; computation of optimum and economic yield.

Teaching

Methods/Activities Classroom teaching with AV aids, group discussions, assignments, and class discussion.

Suggested Reading Brady, N.C. & Weil, R.R. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Education. Fageria, N.K., Baligar, V.C. & Jones, C.A. 1991. Growth and Mineral Nutrition of Field Crops. Marcel Dekker. Havlin, J.L., Beaton, J.D., Tisdale, S.L. & Nelson, W.L. 2006. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall. Prasad, R. & Power, J.F. 1997. Soil Fertility Management for Sustainable Agriculture. CRC Press. Yawalkar, K.S., Agrawal, J.P. & Bokde, S. 2000. Manures and Fertilizers. Agri-Horti Publishing.

SOA/AGRON/C-103	Principles and Practices of Weed Management	3(2+1)	60+40
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Objective: To comprehend weed biology, ecology, and classification.

Outcome: Attain a comprehensive understanding of weed biology, ecology, and classification.

Theory

UNIT I

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

UNIT II

Introduction to herbicides and the history of their development; classification based on chemistry, physiological application, and selectivity; mode and mechanism of action of herbicides.

UNIT III

Herbicide structure-activity relationship; factors affecting the efficiency of herbicides; herbicide formulations; herbicide mixtures; sequential application and rotation of herbicides; weed control through the use of nano-herbicides, bio-herbicides, myco-herbicides, bio-agents, and allelochemicals; movement of herbicides in soil and plants; degradation of herbicides in soil and plants; herbicide resistance, residues, persistence, and management; development of herbicide resistance in weeds and crops and its management; herbicide combinations and rotation.

UNIT IV

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

UNIT V

Integrated weed management; recent developments in weed management, including robotics, the use of drones and aeroplanes, and organic approaches; cost-benefit analysis of weed management.

Practical

- Identification of major weeds in different crops
- Preparation of a weed herbarium
- Weed surveys in crops and cropping systems
- Crop-weed competition studies and interpretation of weed indices
- Calculation of herbicide requirements
- Use of different spray pumps and nozzles
- Calculation of swath width and weed control economics
- Preparation of herbicide spray solutions for high- and low-volume sprayers
- Analysis of herbicide resistance in plants and soil
- Bioassay of herbicide residues

Teaching methods/activities: Classroom teaching with AV aids, group discussion, and field visits to identify weeds.

Suggested Reading

Zimdahl, R. L. (Ed.). 2018. Integrated Weed Management for Sustainable Agriculture. CRC Press. Jugulan, Mithila (Ed.). 2017. Biology, Physiology and Molecular Biology of Weeds. CRC Press. Das, T. K. 2008. Weed Science: Basics and Applications. Jain Brothers, New Delhi. Chauhan, Bhagirath, and Mahajan, Gulshan. 2014. Recent Advances in Weed Management. Springer. Fennimore, Steven A., and Bell, Carl. 2014. Principles of Weed Control, 4th ed. California Weed Science Society. Monaco, T. J., Weller, S. C., and Ashton, F. M. 2014. Weed Science: Principles and Practices. Wiley. Gupta, O. P. 2007. Weed Management: Principles and Practices, 2nd ed. Walia, U. S. 2006. Weed Management. Kalyani. Böger, Peter, Wakabayashi, Ko, and Hirai, Kenji (Eds.). 2002. Herbicide Classes in Development: Mode of Action, Targets, Genetic Engineering, Chemistry. Springer. Powles, S. B., and Shaner, D. L. 2001. Herbicide Resistance and World Grains. CRC Press.

SOA/AGRON/C-104	Principles and Practices of Water Management	3(2+1)	60+40
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Objective: To develop knowledge and practical understanding of soil-water-plant relationships, crop water requirements, irrigation and drainage methods, water quality, and efficient water management practices for optimizing crop productivity.

Outcome: At the end of the course, students will be able to understand and apply principles of soil-water-plant relationships and water management, including crop water requirement assessment, irrigation and drainage methods, water quality management, and water management practices for field crops to improve productivity.

Theory

UNIT I: Water and its role in plants; irrigation: definition and objectives, water resources and irrigation development in India and the 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 conditions. 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 methods of irrigation; micro irrigation systems; deficit irrigation; fertigation; management of water in controlled environments and polyhouses. Irrigation efficiency and water use efficiency.

UNIT IV: Water management of crop and cropping system; quality of irrigation water and management of saline water for irrigation; water use efficiency; crop water requirement-estimation of ET and effective rainfall; water management of the major crops and cropping systems; automated irrigation system.

UNIT V: Excess soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing; rainwater 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, rainwater management and its utilization for crop production.

UNIT VIII: Hydroponics.

UNIT IX: Water management of crops under a climate change scenario.

Practical

Determination of field capacity by field method; permanent wilting point by sunflower pot culture technique; field capacity and permanent wilting point by Pressure Plate Apparatus; hygroscopic coefficient; maximum water-holding capacity of soil; matric potential using gauge and mercury-type tensiometer; soil-moisture characteristic curves; saturated hydraulic conductivity by constant and falling head methods; hydraulic conductivity of saturated soil below the water table by auger hole method; soil water diffusivity; unsaturated hydraulic conductivity; upward flux of water using tensiometer and from depth to groundwater table; irrigation requirement of crops (calculations); effective rainfall (calculations); ET of crops by soil moisture depletion method; 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; infiltration rate by double-ring infiltrometer. Teaching methods/activities: classroom teaching with AV aids, group discussion, assignments, and field visits.

Suggested Reading

Majumdar, D.K. 2014. Irrigation Water Management: Principles and Practice. PHI Learning Private Publishers. Mukund Joshi. 2013. A Text Book of Irrigation and Water Management. Kalyani Publishers. Lenka, D. 1999. Irrigation and Drainage. Kalyani. Michael, A.M. 1978. Irrigation: Theory and Practice. Vikas Publishing. Paliwal, K.V. 1972. Irrigation with Saline Water. IARI Monograph, New Delhi. Panda, S.C. 2003. Principles and Practices of Water Management. Agrobios. Prihar, S.S. & Sandhu, B.S. 1987. Irrigation of Food Crops - Principles and Practices. Reddy, S.R. 2000. Principles of Crop Production. Kalyani. Singh Pratap & Maliwal, P.L. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishers.

Supporting			
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SOA/AGRON/SC-101	Statistical Methods for Applied Sciences	3(2+1)	60+40
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- **Objective:** To impart concepts of statistical methods and statistical inference that would help students understand the importance of statistics.
- **Outcome:** Students will gain comprehensive knowledge of fundamental statistical concepts, including descriptive statistics, probability theory, and exploratory data analysis.

Theory

UNIT I

Classification, tabulation, and graphical representation of data; box plots; descriptive statistics; exploratory data analysis; theory of probability; random variables; and mathematical expectation.

UNIT II

Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial, Normal, Beta, and Gamma distributions and their applications. Concept of sampling distributions: chi-square, t, and F distributions. Tests of significance based on Normal, chi-square, t, and F distributions. Large sample theory.

UNIT III

Introduction to the theory of estimation and confidence intervals. Correlation and regression. Simple and multiple linear regression models, estimation of parameters, predicted values, and residuals; correlation; partial correlation coefficient; multiple correlation coefficient; rank correlation; tests of significance of correlation coefficients and regression coefficients. Coefficient of determination. Polynomial regression models and their fitting. Probit regression analysis by least squares and maximum likelihood methods, confidence interval for sensitivity, and testing for heterogeneity.

UNIT IV

Non-parametric tests: sign test, Wilcoxon test, Mann-Whitney U test, Wald-Wolfowitz runs test, run test for the randomness of a sequence, median test, Kruskal-Wallis test, Friedman two-way ANOVA by ranks, and Kendall's coefficient of concordance.

UNIT V

Introduction to multivariate analytical tools: Hotelling's T^2 , tests of hypothesis about the mean vector of a multinormal population, classificatory problems and discriminant function, D^2 statistic and its applications, cluster analysis, principal component analysis, canonical correlation, and factor analysis.

Practical

- Exploratory data analysis • Box-Cox plots; fitting of Binomial, Poisson, Negative Binomial, and Normal distributions • Large-sample tests; hypothesis testing based on exact sampling distributions: chi-square, t, and F
- Confidence interval estimation and point estimation of parameters of Binomial, Poisson, and Normal distributions • Correlation and regression analysis; fitting of orthogonal polynomial regression • Applications of dimensionality reduction and discriminant function analysis; nonparametric tests

Suggested Reading: Anderson, T. W. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley. Dillon, W. R., & Goldstein, M. 1984. Multivariate Analysis: Methods and Applications. John Wiley. Goon, A. M., Gupta, M. K., & Dasgupta, B. 1977. An Outline of Statistical Theory. Vol. I. The World Press. Goon, A. M., Gupta, M. K., & Dasgupta, B. 1983. Fundamentals of Statistics. Vol. I. The World Press. Hoel, P. G. 1971. Introduction to Mathematical Statistics. John Wiley. Hogg, R. V., & Craig, T. T. 1978. Introduction to Mathematical Statistics. Macmillan. Morrison, D. F. 1976. Multivariate Statistical Methods. McGraw Hill. Siegel, S., Johan, N., & Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley. Learning Statistics: <http://freestatistics.altervista.org/en/learning.php> Electronic Statistics Textbook: <http://www.statsoft.com/textbook/stathome.html>

Common			
SOA/AGRON/CC-101	Technical Writing and Communication Skills	1(0+1)	60+40
SOA/AGRON/CC-102	Basic Concept in Laboratory Techniques	1(0+1)	60+40
SOA/AGRON/CC-103	Intellectual Property and its management in Agriculture	1 (1+0)	60+40

Technical Writing and Communications Skills

- **Objective:** To equip the students/scholars with skills to write dissertations, research papers, etc.
- **Outcome:** Develop an understanding of principles and methods of effective and professional communication and speech.

Practical Technical Writing

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc

Various parts of the 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 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 proofreading; 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

Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India. Collins' Cobuild English Dictionary. 1995.

Harper Collins. Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed.

Holt, Rinehart & Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press. James HS. 1994. Handbook for Technical Writing. NTC Business Books.

Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press. Mohan K. 2005. Speaking English Effectively. MacMillan India.

Richard WS. 1969. Technical Writing. Barnes & Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek. Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.

Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

Basic Concepts in Laboratory Techniques

Objective: To acquaint students with the basic laboratory techniques, handling of chemicals and equipment, preparation of acids, bases, and solutions, use of commonly used instruments, seed viability testing, tissue culture of plants, and description of flowering plants.

Outcome: Upon completion of the course, students will be able to understand and follow laboratory rules and regulations, safely handle chemicals and equipment, prepare solutions, test samples, operate laboratory

instruments efficiently, and design appropriate scientific procedures to ensure accurate results.

Practical

- Lab safety and chemical handling
- Use, cleaning, drying, and sterilization of laboratory glassware and equipment
- Drying of solvents and chemicals
- Weighing; preparation and dilution of solutions of varying strengths
- Handling of solutions; preparation of agrochemical doses for field and pot use
- Preparation of acids, neutralization of acids and bases, and buffer preparation at different pH levels
- Use of microscope, laminar flow, vacuum pump, viscometer, thermometer, magnetic stirrer, ovens, incubators, and baths
- Basic electric wiring, earthing, media preparation, and sterilization methods
- Seed and pollen viability testing
- Tissue culture of crop plants and botanical description of flowering plants for taxonomy

Suggested Reading

- Furr AK. 2000. CRC Handbook of Laboratory Safety. CRC Press.
- Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

Intellectual Property and Its Management in Agriculture

Objective: To provide students and stakeholders with foundational knowledge of intellectual property rights, including patents, copyrights, biodiversity protection, and related legal and ethical frameworks at the national and international levels.

Outcome: Upon completion of the course, students will be able to understand and evaluate the principles, processes, protections, and ethical issues related to intellectual property rights, including patents, copyrights, TRIPS, geographical indications, indigenous traditional knowledge, and plant variety protection.

Theory

Historical perspectives and the need for the introduction of Intellectual Property Rights

TRIPS and various provisions in the TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR); benefits of securing IPRs; Indian legislation for the protection of various types of intellectual property; 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 matter; protection in biotechnology; protection of other biological materials; ownership and period of protection; national biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; licensing of technologies; material transfer agreements; research collaboration agreements; license agreements.

Suggested Reading

Erbisch, F. H., & Maredia, K. (1998). Intellectual Property Rights in Agricultural Biotechnology. CABI.
Ganguli, P. (2001). Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
Intellectual Property Rights: Key to New Wealth Generation. (2001). NRDC & Aesthetic Technologies.
Ministry of Agriculture, Government of India. (2004). State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
Rothschild, M., & Scott, N. (Eds.). (2003). Intellectual Property Rights in Animal Breeding and Genetics. CABI.
Saha, R. (Ed.). (2006). Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publishing House.
The Indian Acts—Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act, 2001, and Rules, 2003; National Biological Diversity Act, 2003.

Semester -II

Major			
SOA/AGRON/C-105	Conservation Agriculture	2(1+1)	60+40
SOA/AGRON/C-106	Agronomy of Major Cereals and Pulses	3(2+1)	60+40

Conservation Agriculture

Objective: To provide students with a comprehensive understanding of conservation agriculture, including its principles, resource management practices, climate change relevance, rainfed applications, and economic considerations.

Outcome: At the end of the course, students will be able to understand and apply the principles of conservation agriculture in relation to resource management, climate change, rainfed farming, and economic aspect.

Theory

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

CA in agroforestry systems; rainfed/dryland regions.

UNIT V

Economic considerations in CA; adoption and constraints; CA: the future of agriculture.

Practical

Study of long-term experiments on CA. Evaluation of soil health parameters. Estimation of C-sequestration. Machinery calibration for sowing different crops. Weed seed bank estimation under CA. Energy requirements and economic analysis of CA.

Teaching methods/activities: Classroom teaching with AV aids, group discussion, and oral presentations by students.

Suggested Reading

Muhammad, F. and Kamdambot, H.M.S. (2014). Conservation Agriculture. Publisher: Springer, Cham, Heidelberg, New York, Dordrecht, London. DOI: 10.1007/978-3-319-11620.

Bisht, J.K., Meena, V.S., Mishra, P.K. and Pattanayak, A. (2016). Conservation Agriculture: An Approach to Combat Climate Change in Indian Himalaya. Publisher: Springer Nature. DOI: 10.1007/978-981-10-2558-7.

Gracia-Torres, L., Benites, J., Martinez-Vilela, A. and Holgado-Cabera, A. (2003). Conservation Agriculture: Environment, Farmers' Experiences, Innovations, and Socio-economic Policy.

Arakeri, H.R. and Roy, D. (1984). Principles of Soil Conservation and Water Management. Oxford & IBH.

Dhruvanarayana, V.V. (1993). Soil and Water Conservation Research in India. ICAR.

FAO. (2004). Soil and Water Conservation in Semi-Arid Areas. Soils Bulletin, Paper 57.

Yellamanda Reddy, T. and Sankara Reddy, G.H. (1992). Principles of Agronomy. Kalyani.

Agronomy of Major Cereals and Pulses

Objective: To impart knowledge on the origin, history, area, production, varieties, adaptability, climate, soil, water, nutrient management, handling, and processing of major cereals and pulses.

Outcome: Students will gain knowledge of the origin, geographical distribution, climate, varieties, cultural requirements, nutrition, quality components, handling, and processing of major cereal and pulse crops.

Theory

Origin, history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, and handling and processing of produce for maximum production.

Unit I: Rabi cereals

Unit II: Kharif cereals

Unit III: Rabi pulses

Unit IV: Kharif pulses

Practical

- Phenological studies at different crop growth stages
- Crop yield estimation using yield attributes
- Cropping schemes for different farm sizes; calculation of cropping and rotational intensities
- 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, ATER, etc.
- Estimation of protein content in pulses
- Planning and layout of field experiments
- Judging physiological maturity in crops
- Intercultural operations in crops
- Determination of cultivation cost
- Harvest index of crops
- Seed production techniques in selected crops
- Visits to field experiments on cultural practices, fertilizer, weed control, and water management
- Visits to nearby villages to identify crop production constraints

Teaching Methods/Activities

Classroom teaching with AV aids, group discussions, assignments, and class discussions.

Suggested Reading

Das, N. R. 2007. Introduction to Crops of India. Scientific Publishers.

Hunsgi, G., & Krishna, K. R. 1998. Science of Field Crop Production. Oxford & IBH.

Jeswani, L. M., & Baldev, B. 1997. Advances in Pulse Production Technology. ICAR.

Khare, D., & Bhale, M. S. 2000. Seed Technology. Scientific Publishers.

Kumar, Ranjeet, & Singh, N. P. 2003. Maize Production in India: Golden Grain in Transition. IARI, New Delhi.

Pal, M., Deka, J., & Rai, R. K. 1996. Fundamentals of Cereal Crop Production. Tata McGraw-Hill.

Prasad, Rajendra. 2002. Textbook of Field Crop Production. ICAR.

Singh, C., Singh, P., & Singh, R. 2003. Modern Techniques of Raising Field Crops. Oxford & IBH.

Singh, S. S. 1998. Crop Management. Kalyani.

Yadav, D. S. 1992. Pulse Crops. Kalyani.

Common			
SOA/AGRON/CC-104	Library and Information Services	1(1+0)	60+40
SOA/AGRON/CC-105	Agricultural Research, Research Ethics and Rural Development Programme	1(1+0)	60+40

Library and Information Services

- **Objective:** To equip library users with skills to trace information from libraries efficiently.
- **Outcome:** Acquaint with basic terms of library services.: Gain knowledge on abstracts, review collection, citation, bibliography and tracking information.: Develop the ability to compose a review of literature and scientific reports.

Practical

- Introduction to library services • Role of libraries in education, research, and technology transfer • Library

classification systems and organization • Primary, secondary, and tertiary information sources • Abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.) • Tracing information from reference sources; literature survey • Citation techniques and bibliography preparation • Use of CD-ROM databases, Online Public Access Catalogue, and computerized library services • Use of the Internet, including search engines and online resources • E-resource access methods.

Agricultural Research, Research Ethics and Rural Development Programs

Objectives:

Objective: To enlighten students about the organization and functioning of agricultural research systems at the national and international levels, and to impart knowledge of government programs, policies, and the evaluation of rural development initiatives.

Outcome: Upon completion of the course, students will be able to understand the basics of agricultural research and research ethics, gain insights into intensive agricultural development programs, and analyze rural development policies, strategies, evaluation systems, and constraints in their implementation.

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 Reading

Bhalla GS & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.

Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.

Singh K.. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

Minor			
SOA/AGRON/MC-101	Management of Problem Soils and Waters	3(2+1)	60+40
SOA/AGRON/MC-102	Soil Erosion and Conservation	2(2+0)	60+40
SOA/AGRON/MC-103	Principles of Plant Physiology I: Plant Water Relations and Mineral Nutrition	3(2+1)	60+40

Management of Problem Soils and Waters

Objective: To understand problem soils and irrigation water, their characteristics, and the reclamation and management practices used to improve soil health and fertility.

Course Outcome: At the end of the course, students will be able to analyze problem soils and irrigation water quality and apply appropriate reclamation and management practices for their improvement.

Theory

Unit I Area and distribution of problem soils—acidic, saline, and physically degraded soils; origin and basic concepts of problematic soils and the factors responsible.

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

Unit III Management of salt-affected soils; crop salt tolerance, mechanisms, and ratings; meaning of salt stress and its effect on crop growth; monitoring soil salinity in the field; management principles for sandy, clayey, red lateritic, and dryland soils.

Unit IV Acid soils—nature and sources of soil acidity; effects on plant growth; lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

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

Unit VI Agronomic practices related to problematic soils; cropping patterns for utilizing poor-quality groundwater.

Practical

Characterization of acid, acid sulfate, salt-affected, and calcareous soils. Determination of cations (Na⁺, K⁺, Ca⁺⁺, and Mg⁺⁺) in groundwater and soil samples. Determination of anions (Cl⁻, SO₄[—], CO₃[—], and HCO₃⁻) in groundwater and soil samples. Lime and gypsum requirements of acid and sodic soils.

Teaching Methods/Activities Classroom teaching with AV aids, group discussion, and oral presentations by students.

Suggested Reading

Bear, F.E. 1964. Chemistry of the Soil. Oxford & IBH. Jurinak, J.J. 1978. Salt-Affected Soils. Department of Soil Science & Biometeorology, Utah State University. USDA Handbook No. 60. 1954. Diagnosis and Improvement of Saline and Alkali Soils. Oxford & IBH.

Soil Erosion and Conservation

Objective: To understand the causes, processes, and impacts of soil erosion, along with human influences and effective soil conservation methods.

Course Outcome: Students will gain comprehensive knowledge of soil erosion types, estimation methods, conservation agronomic and engineering practices, and control measures for effective soil and water conservation.

Theory

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

Unit II Forms of soil erosion; effects and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity—estimation using the EI30 index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measuring and predicting runoff; and soil loss in relation to soil properties and precipitation.

Unit III Wind erosion—types, mechanisms, factors affecting wind erosion, and the extent of the problem in the country.

Unit IV Principles of erosion control; agronomical and engineering measures; and erosion control structures, including their design and layout.

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

Unit VI Watershed management—concept, objectives, and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects; case studies on watershed monitoring and evaluation; and the use of remote sensing in watershed assessment and planning.

Practical

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

Suggested Reading Biswas, T.D., & Narayanasamy, G. (Eds.). 1996. Soil Management in Relation to Land Degradation and Environment. Bulletin of the Indian Society of Soil Science No. 17. Doran, J.W., & Jones, A.J. 1996. Methods of Assessing Soil Quality. Soil Science Society of America, Special Publication No. 49, Madison, USA. Gurnal Singh, Venkataramanan, C., Sastry, G., & Joshi, B.P. 1990. Manual of Soil and Water Conservation Practices. Oxford & IBH. Hudson, N. 1995. Soil Conservation. Iowa State University Press. Indian Society of Soil Science. 2002. Fundamentals of Soil Science. ISSS, New Delhi. Oswal, M.C. 1994. Soil Physics. Oxford & IBH.

Principles of Plant Physiology I: Plant Water Relations and Mineral Nutrition

- Objective: To impart knowledge in the field of water relations and mineral nutrition.
- Outcome: Ability to understand soil-plant water relations.

Theory

A. Plant Water Relations

1. Soil and Plant Water Relations
2. Water Absorption and Translocation
3. Transpiration and Evaporative Cooling
4. Water Productivity and Water Use Efficiency
5. Moisture Stress and Plant Growth

B. Mineral Nutrition

1. Nutrient Elements and Their Importance
2. Nutrient Acquisition
3. Concept of Foliar Nutrition

Block A: Plant Water Relations

Unit I: Soil and Plant Water Relations Water and its importance; molecular structure, properties, and functions of water. Concept of water potential; plant cell and soil water potential and their components; methods for determining cell and soil water potential; osmosis and diffusion. Soil physical properties and water availability in different soils; water-holding capacity and approaches to improve WHC; concepts of FC and PWP; water-holding polymers and their relevance.

Unit II: Water Absorption and Translocation Root structure and functions; root architecture and its relevance in water mining; mechanisms of water absorption and translocation; theories explaining water absorption and translocation; aquaporins. Mycorrhizal association and its relevance in water mining.

Unit III: Transpiration and Evaporative Cooling Evaporation and transpiration; significance of transpiration; factors regulating transpiration; measurement of transpiration; approaches to minimize evaporation and transpiration; concept of CCATD and its relevance. Energy balance: solar energy input and output at crop canopy level. Stomata: structure, functions, and distribution; molecular mechanisms of stomatal opening and closing; guard cell turgidity; role of K and other osmolytes; role of ABA in stomatal closure; guard cell responses to environmental signals; signaling cascades associated with stomatal opening and closure. Antitranspirants and their relevance in agriculture.

Unit IV: Water Productivity and Water Use Efficiency WUE and its relevance to water productivity; transpiration efficiency as a measure of intrinsic WUE; approaches to measure WUE; stomatal and mesophyll regulation of WUE; Passioura's yield model emphasizing WUE.

Unit V: Moisture Stress and Plant Growth Physiology of water stress in plants; effects of moisture stress at the molecular, cellular, organ, and whole-plant levels. Drought indices, drought tolerance strategies, and drought tolerance traits.

Block B: Mineral Nutrition

Unit I: Nutrient Elements and Their Importance Role of mineral nutrients in plant metabolism; essential elements and their classification; beneficial elements; factors influencing nutrient availability; critical nutrient levels. Functions of mineral elements in plants. Deficiency and toxicity symptoms in plants.

Unit II: Nutrient Acquisition Mechanisms of mineral uptake and translocation; ion transporters; genes encoding ion transporters; localization of transporters; xylem and phloem mobility; nutrient transport to grains at maturity; strategies for mineral acquisition and transport under deficiency. Role of mycorrhiza, root exudates, and PGPR in plant nutrient acquisition.

Unit III: Concept of Foliar Nutrition Foliar nutrition; significance and factors affecting total mineral uptake; foliar nutrient droplet size for effective entry; role of wetting agents in nutrient entry.

Practical

- Preparation of standard solutions and different forms of solutions
- Study of the basic properties of water
- Demonstration of surface tension of water and other solvents
- Measurement of plant water status: relative water content and rate of water loss
- Determination of water potential through tissue volume and Chardakov's test
- Determination of water potential using pressure bomb, osmometer, and psychrometer
- Determination of soil moisture content and soil water potential
- Use of soil moisture probes and sensors
- Measurement of transpiration rate in plants using porometry
- Measurement of CCATD and its relevance
- Demonstration and use of antitranspirants to reduce transpiration
- Influence of potassium and ABA on stomatal opening and closing, respectively
- Identification of deficiency and toxicity symptoms of nutrients
- Effect of water stress on plant growth and development

Suggested Reading

Vilalta JM and Forner NG. 2017. Water potential regulation, stomatal behaviour and hydraulic transport under drought: deconstructing the iso/anisohydric concept. *Plant, Cell and Environment* 40: 962–976. Mangrich AS, Cardoso EMC, Doumer ME, Romão LPC, Vidal M, Rigol A, Novotny EH. Improving the Water-Holding Capacity of Soils in Northeast Brazil by Biochar Augmentation. Chapter 16, pp. 339–354. McElrone AJ, Choat B, Gambetta GA and Brodersen CR. 2013. Water Uptake and Transport in Vascular Plants. *Nature Education Knowledge* 4(5): 6. Hodson RC and Acuff J. 2006. Water transport in plants: anatomy and physiology. In *Tested Studies for Laboratory Teaching*, Vol. 27, pp. 163–183. Chater CCC, Caine RS, Fleming AJ and Gray JE. 2017. *Plant Physiology* 174(2): 624–638. DOI: 10.1104/pp.17.00183. Dietrich P, Sanders D and Hedrich R. 2001. The role of ion channels in light-dependent stomatal opening. *Journal of Experimental Botany* 52(363): 1959–1967. <https://doi.org/10.1093/jexbot/52.363.1959> Sreeman SM, Vijayaraghavareddy P, Sreevathsa R, Rajendrareddy S, Arakesh S, Bharti P, Dharmappa P and Soolanayakanahally R. 2018. Introgression of physiological traits for comprehensive improvement of drought adaptation in crop plants. *Frontiers in Chemistry* 6: 92. Salehi-Lisar SY and Bakhshayeshan-Agdam H. 2016. Drought Stress in Plants: Causes, Consequences, and Tolerance. In *Drought Stress Tolerance in Plants*, Vol. 1, pp. 1–16. Pandey R. 2015. Mineral Nutrition of Plants. DOI: 10.1007/978-81-322-2286-6_20. Barker AV and Pilbeam DJ. 2015.

Handbook of Plant Nutrition. 2nd ed. CRC Press. Vatansever R, Ozyigit II and Filiz E. 2017. Essential and beneficial trace elements in plants and their transport in roots: a review. *Applied Biochemistry and Biotechnology* 181(1): 464–482. Tahat MM and Sijam K. 2012. Arbuscular mycorrhizal fungi and plant root exudate biocommunications in the rhizosphere. *African Journal of Microbiology Research* 6(46): 7295–7301. Rajasekar MD, Nandhini DU and Suganthi S. 2017. Supplementation of mineral nutrients through foliar spray: a review. *International Journal of Current Microbiology and Applied Sciences* 6(3): 2504–2513. <https://doi.org/10.20546/ijcmas.2017.603.283> Tarek A and Hassan ER. 2017. Foliar application: from plant nutrition to biofortification. *Environment, Biodiversity and Soil Security*. DOI: 10.21608/jenvbs.2017.1089.1006.

Supporting			
SOA/AGRON/SC-102	Experimental Designs	3(2+1)	60+40

Objective: To develop students’ understanding and practical skills in planning, designing, conducting, and analyzing agricultural experiments using fundamental experimental designs, factorial experiments, split and strip plot designs, and bioassays.

Outcome: Students will be able to plan, implement, and analyze agricultural experiments effectively using basic and advanced experimental designs and bioassay techniques.

Theory

Unit I Need for designing experiments; characteristics of a good design; basic principles of design—randomization, replication, and local control.

Unit II Uniformity trials; size and shape of plots and blocks; analysis of variance; completely randomized design (CRD), randomized block design (RBD), and Latin square design (LSD).

Unit III Factorial experiments (symmetrical and asymmetrical); orthogonality and partitioning of degrees of freedom; confounding in symmetrical factorial experiments; factorial experiments with a control treatment.

Unit IV Split-plot and strip-plot designs; analysis of covariance; missing plot techniques in randomized block and Latin square designs; transformations; crossover designs; balanced incomplete block design (BIBD); resolvable designs and their applications; lattice and alpha designs—concepts, randomization procedures, analysis, and interpretation of results; response surfaces; experiments with mixtures.

Unit V Bioassays—direct and indirect; indirect assays based on quantal dose-response; parallel-line and slope-ratio assays; potency estimation.

Practical • Analysis of uniformity trial data; formation of plots and blocks; Fairfield Smith’s Law • Analysis of data from CRD, RBD, and LSD • Analysis of factorial experiments with and without confounding • Analysis with missing data • Split-plot and strip-plot designs • Transformation of data • Analysis of resolvable designs • Fitting of response surfaces

Suggested Reading

Cochran, W.G. & Cox, G.M. (1957). *Experimental Designs* (2nd ed.). John Wiley. Dean, A.M. & Voss, D. (1999). *Design and Analysis of Experiments*. Springer. Federer, W.T. (1985). *Experimental Designs*. Macmillan. Fisher, R.A. (1953). *Design and Analysis of Experiments*. Oliver & Boyd. Nigam, A.K. & Gupta, V.K. (1979). *Handbook on Analysis of Agricultural Experiments*. IASRI Publications. Pearce, S.C. (1983). *The Agricultural Field Experiment: A Statistical Examination of Theory and Practice*. John Wiley. Design Resources Server: www.iasri.res.in/design

Semester-III

SOA/AGRON/C-107	Agronomy of Oilseed, Fibre and Sugar Crops	3(2+1)	60+40
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Objective: To provide students with comprehensive knowledge of the origin, distribution, varieties, adaptability, and management practices of major oilseed, fibre, and sugar crops, along with their handling, processing, and nutritional aspects.

Outcome: At the end of the course, students will be able to understand the production, management, quality characteristics, nutrition, handling, and processing of major oilseed, fibre, and sugar crops.

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, and handling and processing of produce for maximum production of:

UNIT I Rabi oilseeds – Rapeseed and mustard, linseed, and niger

UNIT II Kharif oilseeds – Groundnut, sesame, castor, sunflower, soybean, and safflower

UNIT III Fiber crops – Cotton, jute, ramie, and mesta

UNIT IV Sugar crops – Sugar beet and sugarcane

Practical

- Planning and layout of field experiments • Cutting, treatment, and sowing methods of sugarcane setts; tying and propping of sugarcane • Determination of cane maturity and calculation of purity percentage, recovery percentage, and sucrose content in cane juice; phenological studies at different crop growth stages • Intercultural operations in different crops • Cotton seed treatment • Calculation of 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) • Judging physiological maturity in different crops and calculating harvest index • Calculation of cost of cultivation for different crops • Estimation of crop yield based on 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 fibre quality in different fibre crops • Study of seed production techniques in various crops • Visits to field experiments on cultural, fertilizer, weed control, and water management aspects • Visits to nearby villages to identify constraints in crop production

Teaching methods/activities: Classroom teaching with AV aids, group discussion, assignments, and class discussion

SOA/AGRON/S-101	Master's Seminar	1(0+1)	100
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Objective

To develop students' ability to identify, review, organize, and present scientific literature on contemporary topics in agronomy and allied agricultural sciences, and to strengthen their academic communication, critical thinking, and discussion skills.

Course Outcome

At the end of the course, students will be able to select and define a relevant seminar topic in agronomy or allied fields, systematically review scientific literature, organize and present scientific information effectively through manuscripts, abstracts, and oral presentations, critically analyze research findings, respond confidently to discussion, and demonstrate professional communication skills. Practical / Seminar Work

Each student shall prepare and present a seminar on an assigned or approved topic related to agronomy, crop production, soil-water-plant relations, sustainable agriculture, climate-resilient farming, weed management,

nutrient management, organic farming, dryland farming, conservation agriculture, experimental research, or other emerging areas in agricultural sciences.

The seminar work shall include: • Selection and finalization of the seminar topic in consultation with the advisor/faculty • Collection of relevant literature from journals, books, theses, bulletins, and authentic online sources • Preparation of a seminar synopsis and detailed outline • Review and synthesis of published research findings • Preparation of the seminar manuscript with a proper structure: title, abstract, introduction, review of literature, discussion, conclusion, and references • Preparation of presentation slides, charts, tables, figures, and other visual aids • Oral presentation of the seminar before departmental faculty and students • Participation in discussions, question-answer sessions, and peer interaction • Submission of the final corrected seminar report

Suggested Areas/Themes for Seminar: • Modern concepts in crop production • Precision agriculture and digital agronomy • Climate change and crop adaptation • Conservation agriculture • Organic farming • Innovations in weed management • Soil fertility and integrated nutrient management • Water management and irrigation efficiency • Cropping systems and sustainable agriculture • Dryland farming and watershed management • Fodder and forage agronomy • Medicinal and aromatic crops • Agroforestry and agrostology • Experimental design and statistical tools in agricultural research • Emerging technologies such as GIS, GPS, remote sensing, hydroponics, aeroponics, robotics, drones, and AI in agriculture

Teaching Methods/Activities: • Orientation lectures on seminar preparation • Library and database search exercises • Literature review and scientific writing practice • Individual consultation with the advisor/supervisor • Student seminar presentations • Group discussion and peer review • Feedback and revision of the seminar report

Evaluation Pattern (Evaluated by an External Examiner appointed by the University)

Total Marks: 100

Criteria	Marks
Seminar topic selection, relevance, and literature coverage	20
Quality of seminar manuscript/report	20
Organization and clarity of presentation	20
Oral presentation skills and use of audio-visual aids	20
Discussion, response to questions, and participation	20
Total	100

Suggested Reading

- Day, R.A. & Gastel, B. 2012. *How to Write and Publish a Scientific Paper*. Cambridge University Press.
- Alley, M. 2013. *The Craft of Scientific Presentations*. Springer.
- Kumar, R. 2018. *Research Methodology: A Step-by-Step Guide for Beginners*. Sage Publications.
- Cresswell, J.W. 2014. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. Sage Publications.
- Montgomery, D.C. 2017. *Design and Analysis of Experiments*. Wiley.
- Chicago Manual of Style. Latest Edition. University of Chicago Press.
- Relevant review articles, research journals, e-resources, and approved online scientific databases in Agronomy and Agricultural Sciences.

General Guidelines

1. Each student shall present at least one seminar during the semester.
2. The seminar topic should preferably be related to the student's area of specialization or proposed research work.

3. The seminar report must be original, properly referenced, and plagiarism-free.
4. Attendance and active participation in seminar sessions may be treated as part of continuous assessment.
5. The seminar shall be evaluated by the departmental seminar committee/internal examiners as per university norms.

Semester-IV

SOA/AGRON /C-114	Thesis (Thesis must be signed by the Supervisor and having plagiarism certified by the student. Thesis must be checked by the external examiner and viva voce/presentation conducted)	30	100
OR			
SOA/AGRON /C-117	Project Based on seed production of Crops / farmer Field Survey (Projects must be evaluated and viva voce conducted by the external examiners appointed by the University)	30	100

Thesis

Objective: Develop students’ skills to plan, conduct, analyse, and report original research in agronomy and related fields using scientific methods.

Course Outcomes

Students will be able to identify an agronomy research problem, formulate objectives and hypotheses, design and conduct experiments, collect, analyze and interpret data, and prepare, present, and defend a thesis with proper references and plagiarism compliance.

Broad Research Areas: Crop production, cropping systems, soil fertility, nutrient management, weed management, irrigation, conservation agriculture, organic farming, dryland and watershed management, forage and underutilized crops, agroforestry, sustainable agriculture, and climate-resilient/precision agronomy.

Research Components

- Select the research problem with the supervisor.
- Review literature and identify gaps.
- Prepare the research proposal.
- Conduct field, lab, or survey research.
- Record and analyze data.
- Write the thesis in standard chapters.
- Submit a plagiarism-certified thesis.
- Present for viva voce.

Teaching/Learning Activities: Supervisor guidance, literature review, research planning, field/lab work, data analysis, thesis writing, revision, and pre-submission presentation.

Evaluation Pattern: Total Marks: **100** based on:

- quality and relevance of research,
- methodology and execution,
- data analysis and interpretation,
- thesis writing and presentation,

- originality and plagiarism compliance,
- viva voce performance.

General Guidelines

- Topic must match the student's agronomy specialization.
- Work must be original and based on approved objectives.
- Thesis must be signed by the supervisor.
- Plagiarism certification is mandatory.
- Evaluation includes external examiner review and viva voce.
- University thesis format must be followed.

Project

Course Objective

To develop students' practical, analytical, and research skills through field-based project work in seed production of crops or farmer field survey, enabling them to apply agronomic principles, collect and analyze data, and prepare a scientific project report.

Course Outcome:

At the end of the course, students will be able to identify a field problem related to seed production or farming systems, design and conduct a scientific agronomic project, systematically collect and analyze field or survey data, apply relevant agronomic knowledge, interpret findings, and communicate the results effectively through a scientific report, presentation, and viva voce.

Students may undertake a project in either of the following areas:

A. Seed Production of Crops

Projects may include:

- Seed production techniques of cereals, pulses, oilseeds, fodder, or other field crops
- Isolation distance, rouging, and field standards
- Seed purity and germination studies
- Seed treatment and storage studies
- Crop growth, flowering, pollination, and seed setting behavior
- Yield attributes and seed yield estimation
- Economics of seed production
- Comparison of seed production practices under different management conditions

B. Farmer Field Survey

Projects may include:

- Survey of cropping systems in a selected area
- Farmer practices in nutrient, weed, and water management
- Constraints in crop production
- Adoption of organic farming / conservation agriculture / precision agriculture
- Seed use and varietal preferences among farmers
- Irrigation practices and resource-use efficiency
- Climate-related production constraints
- Socio-economic analysis of agronomic practices
- Identification of yield gaps and recommendation of improved technologies

Project Components

The project should include the following stages:

1. Topic Selection

- Selection of project topic in consultation with the supervisor
- Identification of problem, relevance, and scope of study

2. Review of Literature

- Collection of related literature from books, journals, reports, theses, and reliable online sources

- Identification of knowledge gaps and justification of the study

3. Preparation of Project Proposal

- Title of the project
- Objectives
- Materials and methods/survey methodology
- Work plan and timeline

4. Field or Survey Work

For seed production projects:

Responsible for selecting crops and fields, planning and implementing crop production practices, recording observations during crop growth stages, and maintaining field standards and seed production requirements.

For survey projects:

The process involved selecting the village, block, and farmers, preparing an interview schedule or questionnaire, and collecting data through farmer interactions and field observations.

5. Data Recording and Analysis

Recording agronomic, yield, seed quality, and socio-economic data, along with required tabulation and statistical analysis, supports the interpretation of findings.

6. Report Writing

The document includes a title page, certificate, acknowledgement, abstract, introduction, objectives, review of literature, materials and methods, results and discussion, conclusion, recommendations, and references. • Annexures/questionnaire/photographs if needed

7. Presentation and Viva Voce

The project work will be assessed through an oral presentation, responses to examiners' questions, and final evaluation by external examiner(s).

Suggested teaching and learning activities include supervisor consultation, field visits, demonstrations of seed production practices, farmer interactions and interviews, data compilation and analysis, scientific report writing, and oral presentation practice.

8. Evaluation Pattern

Total Marks: 100

A suggested evaluation scheme:

1. Topic selection and project relevance – 10 marks
2. Review of literature and project planning – 10 marks
3. Execution of field work / survey work – 20 marks
4. Data recording, analysis, and interpretation – 20 marks
5. Quality of project report writing – 20 marks
6. Presentation and viva voce – 20 marks

9. General Guidelines

- The project must be related to Agronomy and approved by the supervisor.
- The work should be original and field-based.
- Students must maintain proper records of observations and activities.
- Survey data should be authentic and collected ethically.
- The final report should follow university format.
- The project shall be evaluated by external examiner(s) and through viva voce.

10. Suggested Project Topics

Seed Production Based

- Seed production technology of rice, wheat, maize, mustard, or pulses
- Effect of seed treatment on seed quality and germination
- Comparative economics of certified seed production in major crops
- Field standards and rouging practices in seed production plots
- Seed yield and quality of a selected crop under different nutrient levels

Farmer Field Survey-Based

- Survey of farmer practices in weed management in major crops
- Assessment of irrigation practices and water-use efficiency at the farmer level
- Study of fertilizer use patterns in cereal-based cropping systems
- Adoption status of organic farming in selected villages
- Constraints faced by farmers in pulse production
- Farmer perception of climate change and adaptation strategies in agronomy