SCHOOL OF AGRICULTURE

Ph.D. (Agriculture) – Agronomy

DETAILED SYLLABUS

Ph.D. (Agriculture) Agronomy – Detailed Syllabus

Programme Course Summary

S. No.	Course Code	Course Title	Credits	L-T-P
1	AGRON602	Recent Trends in Crop Growth and Productivity	3	2-0-2
2	AGRON603	Irrigation Management	3	2-0-2
3	AGRON601	Current Trends in Agronomy	3	3-0-0
4	AGRON691	Doctoral Seminar I	1	0-0-2
5	AGRON607	Stress Crop Production	3	2-0-2
6	AGRON604	Recent Trends in Weed Management	2	2-0-0
7	SSC606	Land Use Planning and Watershed Management	2	2-0-0
8	SSC602	Modern Concept in Soil Fertility	2	2-0-0
9	SSC505	Soil Erosion and Conservation	3	2-0-2
10	AGRON692	Doctoral Seminar II	1	0-0-2

Current Trends in Agronomy

Course Title	Current Trends in Agronomy
Course Code	AGRON601
Credit Hours	3 Credits (3-0-0)

Aim of the course: To acquaint the students about recent advances in agricultural production.

Theory

Unit I. Agro-physiological basis of variation in yield; recent advances in soil–plant–water relationship.

Unit II. Globalization of agriculture and WTO; precision agriculture; contract farming; organic farming; marketing and export potential of organic products; certification, labelling and accreditation procedures; and Indigenous Technical Knowledge (ITK) in organic farming.

Unit III. Crop residue management in multiple cropping systems; latest developments in plant management and mechanization in crop production; modern agricultural precision tools and technologies; weed management; cropping systems; grassland management; agroforestry; and allelopathy.

Unit IV. GIS, GPS and remote sensing for crop management; global warming; genetically modified (GM) crops; seed production technology; seed certification; seed multiplication; and hybrid seed production.

Unit V. Concepts of systems agriculture; holistic approach to farming systems; dryland farming; sustainable agriculture and research methodology in Agronomy; conservation agriculture—principles, prospects and importance, potential benefits under climate-change scenarios, and policy issues.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion and oral presentations by students.

Learning Outcome

Students will gain knowledge of recent advances in agricultural production.

Suggested Readings

- Agarwal RL. 1995. Seed Technology. Oxford & IBH.
- Dahiya BS and Rai KN. 1997. Seed Technology. Kalyani.
- Govardhan V. 2000. Remote Sensing and Water Management in Command Areas: Agroecological Perspectives. IBDC.
- ICAR. 2006. Handbook of Agriculture. ICAR.
- Narasaiah ML. 2004. World Trade Organization and Agriculture. Sonali Publications.
- Palaniappan SP and Annadurai K. 2006. Organic Farming – Theory and Practice. Scientific Publishers.
- Sen S and Ghosh N. 1999. Seed Science and Technology. Kalyani.
- Tarafdar JC, Tripathi KP and Kumar M. 2007. Organic Agriculture. Scientific Publishers.
- Kumar R, Swarnkar KS, Singh KS and Narayan S. 2016. A Text Book of Seed Technology. Kalyani Publications.
- Reddy SR and Prabhakara G. 2015. Dryland Agriculture. Kalyani Publishers.

- Gururajan B, Balasubhramanian R and Swaminath V. 2013. Recent Strategies on Crop Production. Kalyani Publishers.
- Venkateswarlu B and Shanker Arun K. 2009. Climate change and agriculture: Adaptation and mitigation strategies. Indian Journal of Agronomy 54(2): 226–230.

Recent Trends in Crop Growth and Productivity

Course Title	Recent Trends in Crop Growth and Productivity
Course Code	AGRON602
Credit Hours	3 Credits (2-0-2)

Aim of the course: To study the physiology of vegetative and reproductive growth in relation to productivity of different crops in various environments.

Theory

Unit I. Plant density and crop productivity; plant and environmental factors; yield and plant distribution; strategies for maximizing solar-energy utilization; leaf area; interception of solar radiation and crop growth; photosynthesis and the photosynthetic apparatus; factors essential for photosynthesis; differences in photosynthetic rates among and within species; physiological limitations to crop yield; solar-radiation concepts and agro-techniques for harvesting solar radiation.

Unit II. Growth analysis: concepts and parameters including crop growth rate (CGR), relative growth rate (RGR), net assimilation rate (NAR), leaf area index (LAI), leaf area duration (LAD) and leaf area ratio (LAR); validity and limitations in interpreting crop growth and development; sigmoid, polynomial and asymptotic growth curves; root systems and root–shoot relationship; principles of intercropping and mixed cropping under rainfed and irrigated conditions; differentiation between intercropping and mixed cropping; and criteria for assessing yield advantages.

Unit III. Competitive relationships and competition functions; biological and agronomic basis of yield advantage under intercropping; physiological principles of dryland crop production, constraints and remedial measures; heat-unit concept of crop maturity, including concepts and types of heat units.

Unit IV. Concept of plant ideotypes; crop physiological and new ideotypes; characteristics of ideotypes for wheat, rice, maize and other crops; concepts and types of growth hormones and their role in field-crop production; and efficient use of resources.

Practical

- Field measurement of root–shoot relationship in crops at different growth stages.
- Estimation of crop-growth parameters such as CGR, RGR, NAR and LAI at different stages of crop growth.
- Computation of harvest index of various crops.
- Assessment of crop yield on the basis of yield-attributing characters.
- Construction of crop-growth curves based on growth-analysis data.
- Computation of competition functions, viz. land equivalent ratio (LER), area-time equivalent ratio (ATER/IER as applicable in the source terminology), aggressivity and competition index in intercropping.
- Study of senescence and abscission indices.
- Analysis of productivity trends in unirrigated areas.
- Analysis of productivity trends in irrigated areas.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion and oral presentations by students.

Learning Outcome

Students will gain knowledge of crop growth and its relationship with agricultural production.

Suggested Readings

- Chopra VL and Paroda RS. 1984. Approaches for Incorporation of Drought and Salinity Resistance in Crop Plants. Oxford & IBH.
- Delvin RM and Vitham FH. 1986. Plant Physiology. CBS Publications.
- Evans LT. 1975. Crop Physiology. Cambridge University Press.
- Evans LT. 1996. Crop Evolution, Adaptation and Yield. Cambridge University Press.
- Gupta US (Ed.). 1995. Production and Improvement of Crops for Drylands. Oxford & IBH.
- Gupta US. 1988. Progress in Crop Physiology. Oxford & IBH.
- Kramer PJ and Boyer JS. 1995. Water Relations of Plants and Soils. Academic Press.
- Mukherjee S and Ghosh AK. 1996. Plant Physiology. Tata McGraw Hill.
- Narwal SS, Politycka B and Goswami CL. 2007. Plant Physiology: Research Methods. Scientific Publishers.
- Taiz L and Zeiger E. 2006. Plant Physiology. Sinauer Associates.

Irrigation Management

Course Title	Irrigation Management
Course Code	AGRON603
Credit Hours	3 Credits (2-0-2)

Aim of the course: To teach students about optimization of irrigation in different crops under variable agro-climatic conditions.

Theory

Unit I. Global water resources; water resources of India; irrigation projects during pre- and post-independence periods and their significance in crop production; irrigation needs; atmospheric, soil, agronomic, plant and water factors affecting irrigation needs; and water deficits and crop growth.

Unit II. Movement of water in soil under saturated and unsaturated conditions; Poiseuille's law and Darcy's law; general equation of saturated and unsaturated water flow in soil; soil–plant–water relationships; evaporation, transpiration and evapotranspiration; significance of transpiration; energy utilization in transpiration; physiological processes and crop productivity.

Unit III. Water requirement and irrigation needs; factors affecting irrigation needs; water-use efficiency; infiltration; water movement under saturated and unsaturated conditions; and management practices for improving crop water-use efficiency.

Unit IV. Soil and plant water potential; soil–plant–atmosphere continuum (SPAC); transpiration and evapotranspiration; significance of transpiration; energy utilization in transpiration; factors affecting evapotranspiration; control of evapotranspiration by mulching and antitranspirants; and fertilizer use in relation to irrigation.

Unit V. Crop water stress, water deficits and crop growth; crop adaptability to water stress; and water availability in relation to nutrient availability.

Unit VI. Application of irrigation water; conveyance and distribution systems; irrigation efficiency; agronomic considerations in the design and operation of irrigation projects; and characteristics of irrigation and farming systems affecting irrigation management.

Unit VII. Strategies for using limited water supplies; factors affecting evapotranspiration; control of evapotranspiration by mulching and antitranspirants; fertilizer use in relation to irrigation; and optimization of available irrigation supplies.

Unit VIII. Land suitability for irrigation; land irrigability classification; integrated water management in command areas; institutions for water management in command areas; farmers' participation in command areas; and irrigation legislation.

Unit IX. Economic analysis of irrigation and crop planning for optimum use of irrigation water.

Unit X. Crop water production function.

Practical

- Determination of water-infiltration characteristics and water-holding capacity of soil profiles.
- Determination of moisture-extraction pattern of crops.
- Determination of water-balance components of transplanted rice by the drum-culture technique.
- Determination of consumptive use and water requirement of a given cropping pattern.

- Determination of crop coefficient of an important crop.
- Planning, designing and installation of a drip-irrigation system.
- Planning, designing and installation of a sprinkler-irrigation system.
- Designing of a drainage channel.
- Measurement of irrigation efficiencies.
- Determination of irrigation timing under different methods of irrigation.
- Visit to an irrigation command area.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion and oral presentations by students.

Learning Outcome

Students will develop knowledge and skills for management of irrigation water for sustainable agriculture.

Suggested Readings

- Singh MP. 2017. Recent Advances in Irrigation Water Management. Kalyani Publishers.
- FAO. 1984. Irrigation Practice and Water Management. Oxford & IBH.
- Michael AM. 1978. Irrigation: Theory and Practice. Vikas Publications.
- Mishra RR and Ahmad M. 1987. Manual on Irrigation and Agronomy. Oxford & IBH.
- Panda SC. 2003. Principles and Practices of Water Management. Agrobios.
- Reddy SR. 2000. Principles of Crop Production. Kalyani.
- Sankara Reddy GH and Yellamanda Reddy. 1995. Efficient Use of Irrigation Water. In: Gupta US (Ed.), Production and Improvement of Crops for Drylands. Oxford & IBH.
- Singh SS. 2006. Principles and Practices of Agronomy. In: Gupta US (Ed.), Production and Improvement of Crops for Drylands. Oxford & IBH.

Recent Trends in Weed Management

Course Title	Recent Trends in Weed Management
Course Code	AGRON604
Credit Hours	2 Credits (2-0-0)

Aim of the course: To teach about the changing weed flora, new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems.

Theory

Unit I. Crop–weed competition in different cropping situations; changes in weed flora, their causes and effects; different methods of weed management; migration, introduction and adaptation of weeds; invasive weeds—their biology and management; mechanisms of invasion, present status and factors influencing weed invasion.

Unit II. Physiological and biological aspects of herbicides; their absorption, translocation, metabolism and mode of action; selectivity of herbicides and factors affecting selectivity.

Unit III. Climatic factors and phytotoxicity of herbicides; fate of herbicides in soil and factors affecting it; degradation of herbicides in soil and plants and factors affecting degradation; primary and secondary metabolites; herbicide-residue management; and adjuvants.

Unit IV. Advances in herbicide products and application techniques and methods; herbicide resistance; antidotes and crop-protection compatibility of herbicides of different groups; compatibility of herbicides with other pesticides; herbicide rotation and herbicide mixtures.

Unit V. Development of transgenic herbicide-resistant crops; herbicide development and registration procedures.

Unit VI. Relationship of herbicides with tillage, fertilizers, irrigation and cropping systems; bioherbicides; allelochemicals and alleloherbicides; herbicide bioassays; and recent advances in non-chemical weed management, including deleterious rhizobacteria, robotics and biodegradable films.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion and oral presentations by students.

Learning Outcome

Students will gain knowledge of new herbicides, herbicide resistance, toxicity, antidotes and residue management under different cropping systems.

Suggested Readings

- Böger P, Wakabayashi K and Hirai K (Eds.). 2002. Herbicide Classes in Development: Mode of Action, Targets, Genetic Engineering, Chemistry. Springer.
- Das TK. 2008. Weed Science: Basics and Applications. Jain Brothers, New Delhi.
- Fennimore SA and Bell C. 2014. Principles of Weed Control. 4th Ed. California Weed Science Society.
- Gupta OP. 2007. Weed Management: Principles and Practices. 2nd Ed.
- Jugulam M (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. Scientific Publications.

Stress Crop Production

Course Title	Stress Crop Production
Course Code	AGRON607
Credit Hours	3 Credits (2-0-2)

Aim of the course: To study various types of stresses in crop production and strategies to overcome them.

Theory

Unit I. Stress and strain terminology; nature of stress injury and resistance; and causes of stress.

Unit II. Low-temperature stress: freezing injury and resistance in plants; measurement of freezing tolerance; chilling injury and resistance in plants; and practical ways to overcome the effects of low-temperature stress through soil and crop manipulations.

Unit III. High-temperature or heat stress: meaning of heat stress; heat injury and resistance in plants; and practical ways to overcome the effects of heat stress through soil and crop manipulations.

Unit IV. Water-deficit stress: meaning of plant water-deficit stress and its effects on growth and development; water-deficit injury and resistance; and practical ways to overcome the effects of water-deficit stress through soil and crop manipulations.

Unit V. Excess-water or flooding stress: meaning and kinds of excess-water stress and their effects on crop plants; excess-water stress injury and resistance; and practical ways to overcome excess-water stress through soil and crop manipulations.

Unit VI. Salt stress: meaning of salt stress and its effects on crop growth; salt-stress injury and resistance in plants; and practical ways to overcome the effects of salt stress through soil and crop manipulations.

Unit VII. Mechanical impedance of soil and its impact on plant growth; measures to overcome soil mechanical impedance.

Unit VIII. Environmental pollution: air, soil and water pollution and their effects on crop growth and quality of produce; ways and means to prevent environmental pollution.

Practical

- Determination of electrical conductivity of plant cell sap.
- Determination of osmotic potential and tissue water potential.
- Measurement of transpiration rate.
- Measurement of stomatal frequency.
- Measurement of relative water content of leaf.
- Measurement of electrolytic leakage.
- Growing of plants in sand culture under salt stress for biochemical and physiological studies.
- Studies on the effects of osmotic and ionic stress on seed germination and seedling growth.
- Measurement of low-temperature injury under field conditions.
- Studies on plant responses to excess water.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion and oral presentations by students.

Learning Outcome

Students will gain knowledge of various types of stresses in crop production and strategies to overcome them.

Suggested Readings

- Baker FWG. 1989. Drought Resistance in Cereals. Oxon, UK.
- Gupta US (Ed.). 1988. Physiological Aspects of Dryland Farming. Oxford & IBH.
- Kramer PJ. 1983. Water Relations of Plants. Academic Press.
- Levitt J. 1980. Responses of Plants to Environmental Stresses. Vols. I and II. Academic Press.
- Mavi HS. 1978. Introduction to Agro-meteorology. Oxford & IBH.
- Michael AM and Ojha TP. 1981. Principles of Agricultural Engineering. Vol. II. Jain Brothers.
- Nilsen ET and Orcutt DM. 1996. Physiology of Plants under Stress – Abiotic Factors. John Wiley & Sons.
- Singh K. 2000. Plant Productivity under Environmental Stress. Agrobios.
- Singh KN and Singh RP. 1990. Agronomic Research Towards Sustainable Agriculture. Indian Society of Agronomy, New Delhi.
- Somani LL and Totawat KL. 1992. Management of Salt-affected Soils and Waters. Agrotech Publications.
- Virmani SM, Katyal JC, Eswaran H and Abrol IP. 1994. Stressed Ecosystem and Sustainable Agriculture. Oxford & IBH.

Land Use Planning and Watershed Management

Course Title	Land Use Planning and Watershed Management
Course Code	SSC606
Credit Hours	2 Credits (2-0-0)
Aim of the Course	To develop an understanding of soil and land resources, sustainable land management, land capability and land-use planning, land degradation and watershed-based resource management.

Theory

Unit 1. Relevance of soil management to sustainable agriculture; soil as a natural resource for biomass production, filtering, buffering and transportation of solutes; soil as a source and sink of greenhouse gases.

Unit 2. Concepts and principles of sustainable land management; spatial variability of soils; soil quality and food security; soil quality indices; conservation agriculture in relation to soil quality; soil resilience and resistance.

Unit 3. Types, factors and causes of land degradation and desertification; GLASOD classification; application of GIS and remote sensing in monitoring, diagnosis and mapping land degradation; forms and impacts of soil erosion; strategies for erosion control and conservation in hilly, arid, semi-arid and other problem areas.

Unit 4. Soil conservation planning; land capability classification; land evaluation and rational land use; reclamation and restoration of degraded lands, including salt-affected soils, mine lands, wetlands and other problem areas.

Unit 5. Watershed management: concepts, objectives and approaches; water harvesting and recycling; flood control; socio-economic dimensions; monitoring and evaluation of watershed programmes; case studies.

Unit 6. Agro-ecological regions of India; potentials and constraints of soils in different regions; decision-support systems for land management; national and international soil and land-use policy considerations.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion, student presentations, case studies and field-based learning, wherever applicable.

Learning Outcome

Students will be able to interpret soil and land resources, assess land degradation, apply land capability and land evaluation concepts, and explain integrated watershed-based approaches for sustainable land-use planning.

Suggested Readings

- Abrol IP and Dhruvanarayana VV. 1990. Technology for Wasteland Development. ICAR, New Delhi.

- Blackwell, Dent D and Young A. 1981. Soil Survey and Land Evaluation. George Allen and Unwin, London.
- Burrough PA and McDonnell RA. 1998. Principles of Geographical Information Systems. Oxford University Press.
- FAO. 1996. Land Quality Indicators and Their Use in Sustainable Agriculture and Rural Development. FAO, Rome.
- Indian Society of Soil Science. 2002. Fundamentals of Soil Science. ISSS, New Delhi.

Modern Concept in Soil Fertility

Course Title	Modern Concept in Soil Fertility
Course Code	SSC602
Credit Hours	2 Credits (2-0-0)
Aim of the Course	To provide knowledge of modern concepts of soil fertility and nutrient use in crop production.

Theory

Unit 1. Nutrient availability: concepts and relationships; modern concepts of nutrient availability; soil colloids and nutrient availability; soil amendments and maintenance of nutrient availability; soil solution and plant growth; nutrient response functions and availability indices.

Unit 2. Nutrient movement in soils and absorption by plants; mechanistic approach to nutrient supply and uptake; models for transformation and movement of major and micronutrients in soils.

Unit 3. Chemical equilibria, including solid-solution equilibria involving nutrient ions in soils, particularly submerged soils; kinetic studies of nutrients in soils.

Unit 4. Modern concepts of fertilizer evaluation, nutrient-use efficiency and nutrient budgeting.

Unit 5. Modern concepts in fertilizer application; soil fertility evaluation techniques; role of soil testing in fertilizer-use recommendations; site-specific nutrient management for precision agriculture.

Unit 6. Monitoring physical, chemical and biological changes in soils; permanent manurial trials and long-term fertilizer experiments; soil productivity under long-term intensive cropping; direct, residual and cumulative effects of fertilizer use.

Unit 7. Carbon as a nutrient central to soil fertility; carbon cycle, stocks, pools and fluxes; greenhouse effect and climate change; carbon sequestration in relation to soil quality and crop productivity.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion, student presentations, case studies and field-based learning, wherever applicable.

Learning Outcome

Students will understand contemporary concepts of nutrient availability, movement and transformation, and will be able to interpret nutrient-use efficiency, soil fertility evaluation and long-term soil fertility trends.

Suggested Readings

- Barber SA. 1995. Soil Nutrient Bioavailability. John Wiley & Sons.
- Brady NC and Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Education.
- Epstein E. 1987. Mineral Nutrition of Plants: Principles and Perspectives. International Potash Institute.
- Prasad R and Power JF. 1997. Soil Fertility Management for Sustainable Agriculture. CRC Press.
- Stevenson FJ and Cole MA. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.
- Tisdale SL, Nelson WL, Beaton JD and Havlin JL. 1990. Soil Fertility and Fertilizers. 5th Ed. Macmillan.

Soil Erosion and Conservation

Course Title	Soil Erosion and Conservation
Course Code	SSC505
Credit Hours	3 Credits (2-0-2)
Aim of the Course	To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion and conserving soil and water.

Theory

Unit 1. History, distribution, identification and description of soil erosion problems in India.

Unit 2. Forms and effects of soil erosion; factors affecting erosion; types and mechanisms of water erosion; raindrop impact; rainfall erosivity and its estimation using EI30 index and kinetic energy; empirical and quantitative estimation of water erosion; measurement and prediction of runoff; soil loss in relation to soil properties and precipitation.

Unit 3. Wind erosion: types, mechanisms and factors affecting wind erosion; extent and distribution of wind erosion problems in India.

Unit 4. Principles of erosion control; agronomical and engineering measures of erosion control; erosion-control structures, their design and layout.

Unit 5. Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged areas and wetlands.

Unit 6. Watershed management: concepts, objectives and approaches; water harvesting and recycling; flood control; socio-economic aspects; monitoring and evaluation of watersheds; use of remote sensing in watershed assessment and planning; sediment measurement.

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 kinetic energy of falling raindrops.
- Computation of rainfall erosivity index (EI30) using rain-gauge data.
- Land capability classification of a watershed.
- Field visit to a watershed and study of soil and water conservation measures.

Teaching Methods/Activities

Classroom teaching with audio-visual aids, group discussion, student presentations, case studies and field-based learning, wherever applicable.

Learning Outcome

Students will be able to identify and assess water and wind erosion, calculate selected erosion indices, evaluate conservation measures and apply watershed-management concepts to soil and water conservation problems.

Suggested Readings

- Biswas TD and Narayanasamy G (Eds.). 1996. Soil Management in Relation to Land Degradation and Environment. Bulletin of the Indian Society of Soil Science No. 17.
- Doran JW and Jones AJ. 1996. Methods of Assessing Soil Quality. SSSA Special Publication No. 49.
- Gurmel Singh, Venkataramanan C, Sastry G and Joshi BP. 1990. Manual of Soil and Water Conservation Practices. Oxford & IBH.
- Hudson N. 1995. Soil Conservation. Iowa State University Press.
- Indian Society of Soil Science. 2002. Fundamentals of Soil Science. ISSS, New Delhi.

Doctoral Seminar I

Course Title	Doctoral Seminar I
Course Code	AGRON691
Credit Hours	1 Credit (0-0-2)
Aim of the Course	To develop the scholar's ability to identify and critically review a contemporary research problem in Agronomy, synthesize relevant scientific literature and communicate research ideas effectively.

Seminar Components

Component 1. Selection and delimitation of a current research theme relevant to Agronomy and consultation with the Major Advisor.

Component 2. Systematic collection of recent scientific literature from peer-reviewed journals, books, theses and authoritative databases.

Component 3. Critical appraisal of published research: objectives, hypotheses, experimental approaches, major findings, limitations and research gaps.

Component 4. Organization and synthesis of literature; development of a clear scientific rationale and research questions.

Component 5. Preparation and delivery of a structured oral seminar, including effective use of tables, figures, references and audio-visual aids.

Component 6. Scientific discussion, response to questions and incorporation of academic feedback.

Teaching/Learning Activities

Independent literature study, consultation with the Major Advisor, preparation of seminar material, oral presentation using audio-visual aids, question-and-answer session and participation in academic discussion.

Learning Outcome

The scholar will be able to search and critically evaluate scientific literature, identify research gaps, organize scientific information and deliver a coherent academic presentation.

Evaluation

Suggested evaluation may consider quality and relevance of literature, critical analysis, organization of the presentation, oral communication, use of references and response to questions.

Doctoral Seminar II

Course Title	Doctoral Seminar II
Course Code	AGRON692
Credit Hours	1 Credit (0-0-2)
Aim of the Course	To strengthen the scholar's ability to critically present and discuss advanced research developments, research methodology and/or progress in the approved doctoral research area.

Seminar Components

Component 1. Selection of an advanced or emerging research theme closely related to the scholar's doctoral research area, in consultation with the Major Advisor.

Component 2. Review and critical synthesis of recent research findings, concepts, methodologies and technological developments.

Component 3. Scientific justification of research methods, experimental design, analytical approaches and interpretation of relevant findings, as applicable.

Component 4. Presentation of research progress, preliminary observations or a critical appraisal of the selected theme, as approved by the Major Advisor.

Component 5. Discussion of limitations, unresolved questions, future research directions and implications for crop production and sustainable agriculture.

Component 6. Preparation and delivery of an advanced seminar, followed by critical discussion and responses to questions.

Teaching/Learning Activities

Independent literature study, consultation with the Major Advisor, preparation of seminar material, oral presentation using audio-visual aids, question-and-answer session and participation in academic discussion.

Learning Outcome

The scholar will be able to critically discuss advanced research in Agronomy, communicate research progress or a specialized scientific theme, defend scientific arguments and identify future research directions.

Evaluation

Suggested evaluation may consider depth of scientific understanding, critical interpretation, methodological clarity, relevance to doctoral research, presentation quality and response to questions.