

SHRI GURU RAM RAI UNIVERSITY

Patel Nagar, Dehradun-248001, Uttarakhand, India

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s 2(f) of UGC Act 1956]



SYLLABUS (2021-2022)

PRE-Ph.D. COURSE (AGRONOMY)

Table: The course structure and Assessment scheme:

S. No.	Course code	Subject	Credits (L:T:P)	Total credit	Total marks	Minimum marks for completion
Core Courses						
1.	PRMC-101	Research Methodology	4 (2:1:1)	4	80	40
2.	PREC-102	Research & Publication Ethics	2 (1:1:0)	2	40	20
3.	PPAC101	Advances in crop growth and productivity	4 (2:1:1)	4	80	40
4.	PPAC102	Doctoral Seminar- I	2 (0:0:2)	4	80	40
		Doctoral Seminar- II	2(0:2:0)			
Elective Courses*						
5.	PPAE103	Current trends in agronomy	4 (2:1:1)	4	80	40
	PPAE104	Dryland farming and watershed management	4 (2:1:1)			
	PPAE105	Analytical techniques and instrumental methods in soil and plant analysis	4 (2:1:1)			
	PPAE106	Irrigation management	4 (2:1:1)			
Total				18	360	-
Ph. D. Thesis Research**						
6.	Ph. D. Thesis Research			NA	Non gradial	

*Elective courses (Students have to select any *one* course from above elective courses)

**After completion of pre-Ph.D. course work, student has to register for Ph.D. Agronomy. He/she will have to fill up a prescribed admission form of university and submit along with the synopsis on a proposed research work under the designated supervisor of the university.

Programme Outcomes (POs)

PO 1.	Develop deeper understanding of a subject for its application in addressing social and scientific issues.
PO 2.	To understand the critical aspects of conducting ethical research for sustainable development
PO 3.	To develop the reasoning based solution to the scientific problem.
PO 4.	To understand the impact of research & development on environment safety and sustenance
PO 5.	Inculcate the leadership skills required to identify the problem and finding the solution in coherence with the teamwork.
PO 6.	To develop the skill set of designing and executing experiments pertaining to a targeted scientific problem.
PO 7.	Develop the analytical skills prerequisite for analyzing the research findings and correlating with the set objectives.
PO 8.	Develop meticulous scientific writing skills for presenting the research outcomes.

Programme Specific Outcomes (PSOs)

P.S.O.1:	To develop the skills of current trends in Agronomy
P.S.O.2:	To educate the various management strategies for optimization of quality and quantity of yield and yield attributing characters.
P.S.O.3:	To disseminate principles, planning, layout and analysis of major of field designs
P.S.O.4:	Develop skills in ethical dimensions of research work and knowledge to obtain appropriate approval.

Paper-I: Research Methodology (Compulsory)

Course Code: PRMC-101

Credit: 4 (2:1:1)

Objective:

To apprise students with the knowledge of statistical methods and techniques, and their application in seed science and technology.

UNIT -I : Concept & Types of Research

Meaning and importance of Research – Types of Research – Selection and formulation of Research Problem – Research Design, Classification of Research, Pure and Applied Research, Exploring or Formulative Research, Descriptive Research, Diagnostic Research/Study, Evaluation research/Studies, Action Research, Experimental Research, Analytical Study of Statistical Method, Historical Research,

UNIT-II :Methods Research

Surveys, Case Study, Field Studies General Survey of various Methods including Survey Method, Interdisciplinary Method, Cash Study Method, Sampling Method, Statistical Method, Observation Method, Interview Method, Schedule Method, Questionnaire Method, Documentary Method, Library Method, Historical Method and Scientific Method. Characteristic Features of Scientific Method; Empirical Verifiable, Cumulative, Self - Correcting, Deterministic, Ethical & Ideological neutrality (Value Free).

UNIT- III: Data Collection and Data Analysis

Collection, Objectives and Classification of Data, Aims, Methods and Objects of Tabulation of Data, Forms and Processes of Interpretation and Presentation of Data.

Primary, Secondary and Tertiary Data. Construction and adaptation of instruments, administration of questions and tests, Tabulation of data. Data organization in SPSS & Excel, Graphical representation of data.

Definition and Aims of Content Analysis, Problems of Content Analysis, Computer and Content Analysis Discussion and Interpretation of results, Testing of Hypothesis: Logical and Statistical Techniques.

UNIT –IV: Report Writing

Locating Information on a Topic of Interest, Acquiring Copies of Articles of Interest, The Nature of Scientific Variables, Conceptual Versus Operational Definitions of Variables, Levels of Measurement, Various Paradigms including Formism, Mechanism, Organicism, Pragmatism, The Basic Format for a Research Report, Identification of the Parts of a Research Report, Citation and Referencing Styles, Essentials of Report Writing, Aids for Writing Good Research Report.

Course Outcome (COs):

- CO 1. To develop understanding of the basic framework of research process.
- CO 2. To develop an understanding of various research designs and techniques.
- CO 3. To identify various sources of information for literature review and data collection.
- CO 4. To develop an understanding of the ethical dimensions of conducting applied research
- CO 5. Appreciate the components of scholarly writing and evaluate its quality.

Suggested Readings:

- Bagchi, Kanak Kanti (2007) Research Methodology in Social Sciences: A Practical Guide, Delhi, Abijeet Publications.
- Sharma, B.A.V., et al., (2000) Research Methods in Social Sciences, New Delhi, Sterling Publishers
- B.A.V. Busha, C. H and Harter, S. D (1980) Research Methods in Librarianship, New Academic Press.
- Cooper, R. Donald and Pamela S. Schindler (2003) Business Research Methods, Delhi, Tata McGraw-Hill.
- Flyvbjerg, Bent (2001) Making Social Science Matter: Why Social Inquiry Fails and How It can Succeed Again, United Kingdom, Cambridge University Press.
- Goodde and Hatte (1952) Methods in Social Research, New York, McGraw – Hill.
- Gopal, M.H (1970) An Introduction to Research Procedures in Social Sciences, Bombay, Asia Publishing House.
- Hunt, Morton (1989) Profiles of Social Research: The Scientific Study of Human Interactlions, Bombay, Popular Prakashan.
- Kothari, C.R (2004) Research Methodology: An Introduction, Delhi, New Age.

Paper-II: Research & Publication Ethics (Compulsory)

Code: RPEC-102

Credit: 2(1:1:0)

OBJECTIVE

To provide ethical knowledge and values related to agricultural research

UNIT- I

Philosophy and Ethics

Introduction to Philosophy: definition, nature and scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgments and reactions

UNIT- II

Scientific Conduct

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific is conducts: Falsification, Fabrication and Plagiarism (FFP)

- Redundant publications: duplicate and overlapping publications, salami slicing
- Selective reporting and misrepresentation of data

UNIT- III

Publication Ethics

- Publication ethics: definition, introduction and importance
- Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
- Conflicts of interest
- Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice -versa, types
- Violation of publication ethics, authorship and contributorship
- Identification of publication misconduct, complaints and appeals
- Predatory publishers and journals

Practical

Open Access Publishing

- Open access publications and initiatives
- SHERPA/ RoMEO online resource to check publisher copyright & self- archiving policies
- Software tool to identify predatory publications developed by SPPU
- Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Publication Misconduct

Group Discussions

Subject specific ethical issues, FFP, authorship

Conflict of interest, Complaints and appeals: examples and fraud from India and abroad

Software tools

Use of plagiarism software like Turnitin, Urkund and other open source software tools

Databases and Research Metrics

Databases

- Indexing databases
- Citation databases: Web of Science, Scopus, etc.

Research Metrics

- Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
- Metrics: h- index, g index, i10 index, altmetrics

Course Outcome:

CO 1: To develop an understanding of research ethics, publications misconduct and plagiarism.

CO 2: To develop Intellectual honesty and research integrity.

CO3. To identify various sources of information for data bases and research matrices.

CO4. To develop an understanding of Open access publications and initiatives.

CO5. Appreciate the components of scholarly writing and evaluate its quality

Paper-III: Advances in crop growth and productivity (Core Course)

Course Code: PPAC101

Credit: 4 (2:1:1)

OBJECTIVE

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

UNIT-I

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

UNIT -II

Growth analysis: concept, CGR, RGR, NAR, LAI, LAD, LAR; validity and Limitations in interpreting crop growth and development; growth curves: sigmoid, polynomial and asymptotic; root systems; root-shoot relationship; principles involved in inter and mixed cropping systems under rainfed and irrigated conditions; concept and differentiation of inter and mixed cropping; criteria in assessing the yield advantages.

UNIT- III

Competitive relationship and competition functions; biological and agronomic basis of yield advantage under intercropping; physiological principles of dry land crop production, constraints and remedial measures; heat unit concept of crop maturity: concept and types of heat units.

UNIT- IV

Concept of plant ideotypes: crop physiological and new ideotypes; characteristics of ideotype for wheat, rice, maize, etc.; concept and types of growth hormones; their role in field crop production; efficient use of resources

PRACTICAL

- Field measurement of root-shoot relationship in crops at different growth stages
- Estimation of growth evaluating parameters like CGR, RGR, NAR, LAI etc., 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. LER, IER aggressivity competition index etc in intercropping
- Senescence and abscission indices
- Analysis of productivity trend in un-irrigated areas
- Analysis of productivity trend in irrigated areas

Course Outcome (COs):

CO1: Define the crop growth and productivity

CO2: Summarize Plant distribution, Growth analysis.

CO3: Categorize biological and agronomic basis of yield

CO4: Able to formulate and utilize plant hormones and synthetic growth regulators for desired growth and yield of crops

CO5: Able to examine crop growth developmental phases

CO6: Able to recommend suitable package of practices for enhanced production of field crops

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 Publ.
- Evans LT. 1975. *Crop Physiology*. Cambridge Univ. Press.
- **Evans LT. 1996. *Crop Evolution, Adaptation and Yield*. Cambridge Univ. 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 Plant 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 Pub.
- Tiaz L. and Zeiger E. 2006. *Plant Physiology*. Sinauer Associates, Inc

ELECTIVE COURSE-I

CURRENT TRENDS IN AGRONOMY

Course Code: PPAE103

Credit: 4 (2:2:0)

OBJECTIVE

To acquaint the students about recent advances in agricultural production.

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, and labeling and accreditation procedures.

UNIT- III

Crop residue management in multiple cropping systems; latest developments in plant management, weed management, cropping systems, grassland management, agro-forestry, allelopathy.

UNIT- IV

GIS, GPS and remote sensing for crop management, global warming, GM crops, seed production technology; seed certification, seed multiplication, hybrid seed production etc.

UNIT -V

Concepts of system agriculture; holistic approach of farming systems, dryland farming, sustainable agriculture and research methodology in Agronomy.

UNIT -VI

Organic farming-Definition, differences between conventional and organic farming. Principles and components of organic farming.

Course Outcome (COs):

CO 1. acquaint the students about recent advances in agricultural production

CO 2.outline and summarize soil plant-water relationship.

CO 3. Choose GIS, GPS and remote sensing based techniques for crop management

CO4. Explain precision agriculture, contract farming, and organic farming.

CO5. Examine physiology of seed germination, dormancy and seed development under organic production

CO6. Apply organic manures in field crops for increasing quality production

Suggested Readings

- Agarwal RL. 1995. Seed Technology. Oxford & IBH.
- GovardhanV.2000 .Remote Sensing and Water Management in Command Areas: Agro ecological Prospective. IBDC.
- Hand Book of Agriculture 2006. ICAR.
- Narasaiah ML. 2004.World Trade Organization and Agriculture.Sonali Publ.
- Palaniappan SP &Annadurai K. 2006.Organic Farming - Theory and Practice.Scientific Publ. Sen S & Ghosh N. 1999.Seed Science and Technology.Kalyani.
- Tarafdar JC, Tripathi KP & Mahesh Kumar 2007. Organic Agriculture Scientific Publ.

ELECTIVE COURSE-II

DRYLAND FARMING AND WATERSHED MANAGEMENT

Course Code: PPAE104

Credit: 4(2-1-1)

OBJECTIVE:

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

UNIT-I

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture

UNIT -II

Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions

UNIT -III

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

UNIT -IV

Tillage, tith, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants; soil and crop management techniques, seeding and efficient fertilizer use.

UNIT- V

Concept of watershed resource management, problems, approach and components

Practical:

- Seed treatment, seed germination and crop establishment in relation to soil moisture content.
- Moisture stress effects and recovery behavior of important crops
- Estimation of moisture index and aridity index
- Spray of anti-transpirants and their effect on crops
- Collection and interpretation of data for water balance equations and Water use efficiency
- Study of field experiments relevant to dryland farming
- Visit to dryland research stations and watershed projects

Course Outcome (COs):

CO1. Define the basic concepts and practices of dry land farming and soil moisture conservation

CO2. categorize types of drought and management strategies

CO3. Choose soil and crop management techniques

CO4. Explain watershed resource management, problems, approach and components

CO5: Appreciate the research advancements made in the dryland area

CO6: Able to recommend suitable irrigation scheduling practices for enhanced production of crops under stress condition

Suggested Readings

- Das NR. 2007. Tillage and Crop Production. Scientific Publishers. Dhopte AM. 2002. Agrotechnology for Dryland Farming. Scientific Publ.
- Dhruv Narayan VV. 2002. Soil and Water Conservation Research in India. ICAR.
- Gupta US. (Ed.). 1995. Production and Improvements of Crops for Drylands. Oxford & IBH. Katyal JC & Farrington J. 1995. Research for Rainfed Farming. CRIDA.
- Rao SC & Ryan J. 2007. Challenges and Strategies of Dryland Agriculture. Scientific Publishers. Singh P & Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publishing Company.
- Singh RP. 1988. Improved Agronomic Practices for Dryland Crops. CRIDA
- Singh RP. 2005. Sustainable Development of Dryland Agriculture in India. Scientific Publ
- Singh SD. 1998. Arid Land Irrigation and Ecological Management. Scientific Publishers. Venkateshwarlu
- J. 2004. Rainfed Agriculture in India. Research and Development Scenario. ICAR

ELECTIVE COURSE-III

ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS

Course Code: PPAE105

Credit: 4(2-1-1)

OBJECTIVE:

To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples.

Course Outcome (COs):

- CO1. familiarize with commonly used instruments and preparations of common analytical reagents
- CO2.outline and summarize instrumental methods of analysis
- CO3. Determine nutrient potentials and potential buffering capacities of soils nutrients.
- CO4. Analysis of plant materials by digesting plant materials.
- CO5: Appreciate the research advancements made in the field crops
- CO6: Able to recommend suitable irrigation scheduling practices for enhanced production of crops

UNIT- I

General principles of Analytical chemistry-introduction to volumetric analysis Acidimetry, Alkalimetry- Redox reactions – Complexometry, Precipitation reactions – types of indicators and theory of indicators, Gravimetry Principles

UNIT-II

Introduction to instrumental methods of analysis – Electrochemical methods Potentiometry- -pH measurement – Potentiometric titration. Conductometry conductivity measurement- conductometric titration- theory and principles X ray diffraction- Differential thermal analysis-Chromatography- partition, column, paper, Thin, Gas, Gas-Liquid, HPLC- Principles and instrumentation

UNIT- III

Theory and Principles of Spectral methods of Analysis,Nature of electromagnetic radiation, Interaction of EMR with matter, Colorimetry / Spectrophotometry- turbidimetry /Nephelometry

UNIT-IV

Theory and Principles of Emission spectroscopy, Flame photometry, Plasma emission spectroscopy

Atomic absorption spectrophotometry, mass spectrometry and X-ray diffractometry, Nuclear magnetic resonance spectroscopy (NMR). Identification of minerals by X-ray by different methods

Practical:

- Preparation of solutions for standard curves, analytical reagents, qualitative reagents, indicators and standard solutions for acid-base, oxidation reduction and complexometric titration; soil, water and plant sampling techniques, their processing and handling.
- Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.
- Electrochemical titration of clays; determination of cation and anion exchange capacities of soils; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity, analysis of soil and plant samples for N, P, K, Ca, Mg, S, Zn, Cu, Fe, Mn, B and Mo; analysis of plant materials by digesting plant materials by wet and dry ashing and soil by wet digestion methods, drawing normalized exchange isotherms; measurement of redox potential.

Suggested Readings:

- Hesse P. 1971. *Textbook of Soil Chemical Analysis*. William Clowes & Sons. Jackson ML. 1967.
- *Soil Chemical Analysis*. Prentice Hall of India.
- Keith A Smith 1991. *Soil Analysis; Modern Instrumental Techniques*. Marcel Dekker.
- Kenneth Helrich 1990. *Official Methods of Analysis* Association of Official Analytical Chemists.
- Page AL, Miller RH & Keeney DR. 1982. *Methods of Soil Analysis*. Part II. SSSA, Madison. Piper CE. *Soil and Plant Analysis*. Hans Publ
- Singh D, Chhonkar PK & Pandey RN. 1999. *Soil Plant Water Analysis – A Methods Manual*. IARI, New Delhi.
- Tan KH. 2003. *Soil Sampling, Preparation and Analysis*. CRC Press/Taylor & Francis.
- Tandon HLS. 1993. *Methods of Analysis of Soils, Fertilizers and Waters*. FDCO, New Delhi. Vogel
- AL. 1979. *A Textbook of Quantitative Inorganic Analysis*. ELBS Longman.

ELECTIVE COURSE-IV

IRRIGATION MANAGEMENT

Course Code: PPAE 106

4(2-1-1)

OBJECTIVE:

To teach students about optimization of irrigation in different crops under variable agroclimatic conditions

Course Outcome:

CO1. Define optimization of irrigation in different crops

CO2. summarize Soil plant water relationships

CO3. choose, management practices for improving water use efficiency of crops.

CO4. categorize Land suitability for irrigation and land irrigability classification

CO5: Appreciate the research advancements made in the field crops

CO6: Able to recommend suitable irrigation scheduling practices for enhanced production of crops.

UNIT –I

Water resources of India, irrigation projects, irrigation needs, atmospheric, soil, agronomic, plant and water factors affecting irrigation need, water deficits and crop growth. Soil plant water relationships, transpiration and evapotranspiration, significance of transpiration, energy utilization in transpiration, physiological processes and crop productivity.

UNIT- II

Infiltration, water movement under saturated and unsaturated conditions, management practices for improving water use efficiency of crops.

UNIT -III

Application of irrigation water, conveyance and distribution system , irrigation efficiency, agronomic considerations in the design and operation of irrigation projects, characteristics of irrigation and

farming systems affecting irrigation management.

UNIT -IV

Strategies of using limited water supply, factors affecting ET, control of ET by mulching and use of antitranspirants. Fertilizer use in relation to irrigation, optimising the use of given irrigation supplies. Land suitability for irrigation, land irrigability classification, integrated water management in command areas, institution of water management in commands, Farmer's participation in command areas, irrigation legislation

Practical:

- Determination of water infiltration characteristics and water holding capacity of soil profiles.
- Determination Moisture extraction pattern of crops
- Determination of water balance component of transplanted rice by drum culture technique
- Determination of consumptive use and water requirement of a given cropping pattern
- Determination of crop efficient of one important crop
- Planning, designing and installation of drip irrigation system
- Planning, designing and installation of sprinkler irrigation system
- Designing of drainage channel
- Measurement of irrigation efficiencies
- Determination of irrigation timing under different methods of irrigation
- Visit to irrigation command area

Suggested Readings:

- MP. Singh 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 Publ.
- 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 Yellamananda 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