



MOTHERHOOD
UNIVERSITY, Roorkee
ENLIGHTENING WORLD

**Doctor of Philosophy (Ph.D.)
COURSE WORK SYLLABUS**

FACULTY OF AGRICULTURE

Implemented from June, 2017 onwards

**Roorkee-Dehradun Road, Village Karoundi
Post Bhagwanpur, Tehsil Roorkee
District Haridwar, Uttarakhand**

Compulsory Course - I

PAPER I- Research Methodology and Computer Applications

Section I: Research Methodology
6 Credits

Max. Marks: 100
(70 External+30 Internal)

Objective:

- To enable to student to understand and work methods and concepts related Research.
- To enable the student to develop research proposal and to work with research problem.
- To develop broad comprehension of research area.

UNIT –I : Concept of Research

10 hrs (20 Marks)

Meaning, Concept, nature steps types and characteristics of research., Types and approaches , Ethics in Research and Plagiarism, Scientific Inquiry, Philosophical and Sociological foundations of research, Interdisciplinary approach and its implications in various research area.

Unit II: Types and Methods of Research

10 hrs (20 Marks)

Qualitative and quantitative methods of research like Descriptive, Historical, Case study, Ethnography, Ex-post facto, documentary and content analysis, survey field and laboratory experimental studies. Characteristics of methods and their implications in research area.

Unit III: Development of research proposals

10 hrs (20 Marks)

Research proposal and its elements, Formulation of research problem-criteria of sources and definition, Development of objectives and characteristics of objectives, Development of hypothesis and applications.

Writing a Research Paper, Choosing a Topic, Preparing a Working Bibliography, Outlining and need to write a Research Paper

Unit IV: Methods of data collection & data analysis

10 hrs (20 Marks)

Concept of sampling and other concepts related to sampling. Probability and non-probability samples, their characteristics and implications. Tools of data collections, their types, attributes and uses. Redesigning, research tools-like questionnaire, observation, interviews, scales and tests etc.

Analysis of qualitative data based on various tools. Analysis of quantitative data and its presentation with tables, graphs etc. Statistical tools and techniques of data analysis-measures of central tendency, dispersion. Decision making with hypothesis testing through parametric and non-parametric tests.

Validity and delimitations of research findings.

Section II: Computer Applications

Unit V:

20 hrs (20 Marks)

Basic Knowledge of Computer, Use of Internet for Research Purpose: E-mail, WWW, Web browsing, acquiring technical skills, drawing inferences from data, Use of technology and other equipment in Research, Research publishing tool-MS Word, Adobe acrobat, Graphics tool-MS Excel, Presentation tool-MS Power, Data Analysis Software and Analysis Techniques point. Application of Internet in research : INFLIBNET, Use of Internet, sights (DOAJ), Use of E Journals, Use of E library, use of EBSCO HOST online database of Academic Libraries.

References:

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- Edwards, A.L. (1960) – Experimental Design in Psychological Research, New York, Holts (revised Ed.).
- Ferguson, G.A. and Takane Yoshio (1989) – Statistical Analysis in Psychology and Education.
- Garrett, H.E. (1986) – Statistics in Psychology and Education, Vikils Feffers and Simmons Pvt. Ltd.
- Kaul Lokesh (1984) – Methodology of Educational Research, Vikas Publishing House Pvt. Ltd., New Delhi.
- Sukhiya, S. P. : Melhotra P.V., Elements of Educational Research, New Delhi, Allied Publishers.
- Tuckman, B.W. (1972) – Conducting Educational Research, Harcourt Brace, Javanovich.
- Verma, An Introduction to Educational and Psychological Research, Bombay, Asia Publishing House.
- Lindquist, E.F. (1960) – Elementary Statistical Methods in Psychology and Education, Oxford Book Company, New Delhi.
- Sharma, A.R. (1984) Fundamentals of Educational Research, Loyal Book Depot, Meerut.
- Sanders, D.H., Computer Today, NY: McGraw Hill, 1981
- Sinha, P.K., Computer Fundamentals, New Delhi: BPB Publications, 1992
- Cox, J. And Urban, P. “Quick Course in Microsoft Office. Galgotia Publications, New Delhi, 1990.
- Jain, Satish: “Introduction to Computer Science and basic Programming.” BPB Publications, New Delhi, 1990.
- Rajaraman, V., “Fundamental of Computers”, Prentice Hall of India, New Delhi, 1996.
- Saxena, S., “A First Coursein Computers”, Vikas Publishing House Pvt. Ltd., New Delhi, 1998.

**COURSE WORK SYLLABUS
CORE PAPER –II**

(To be selected as per Subject Specialization)

Total Credits : (6 Credits)	Max. Marks 100
RESEARCH METHODOLOGY AND TECHNIQUES	6/ 100
CROP PRODUCTIONS AND SYSTEM MODELING	6/ 100
ADVANCES IN CROP GROWTH AND PRODUCTIVITY	6/ 100
ADVANCES IN SOIL FERTILITY MANAGEMENT	6/ 100
ADVANCES IN IRRIGATION MANAGEMENT	6/ 100
ADVANCES IN WEED MANAGEMENT	6/ 100
INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE	6/ 100
SOIL CONSERVATION AND WATERSHED MANAGEMENT	6/ 100
STRESS CROP PRODUCTION	6/ 100

RESEARCH METHODOLOGY AND TECHNIQUES - 6 Credits/100 Marks

UNIT I Definition, objectives and types of research; Research processes, Criteria of Good Research, Nature and scope of agronomic research. Defining research problems; Research Project Planning and Management.

UNIT II Biometric observations; Analysis of crop growth – recording dry matter, measuring leaf area; Concept of growth analysis parameters – CGR, RGR, LAI, NAR etc; Economics and energetics of crop production.

UNIT III Agro-meteorological observations – data recording, analysis, presentation and interpretation. Correlation studies of weather data and crop growth.

UNIT IV Laboratory techniques involved in soil and plant analysis. Basic knowledge of working in laboratory. Basic principles of laboratory techniques commonly used in agronomic research. Collection of soil and plant samples and processing for laboratory analysis.

UNIT V Basic principles of experimental design; Lay out of field plot experimental design; Data processing and analysis – multiple correlation and regression, analysis of variance and covariance. Test of significance – t test, z test, F test.

UNIT VI Interpretation of result – concept of least significant difference (LSD), DMRT, contrast analysis, missing plot techniques; analysis of cropping system data – intercropping and sequential cropping. Graphical and tabular presentation of data.

UNIT VII Importance and need of scientific temper, values and ethics in research: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT VIII Computer application in agronomic research; Statistical analysis of data by using softwares.

CROP PRODUCTION AND SYSTEM MODELING 6 Credits/100 Marks

UNIT I Systems classification; flow charts, modeling techniques and methods of integration - state, rates and driving variables, feedbacks and relational diagrams.

UNIT II Elementary models for crop growth based on basic methods of classical growth analysis. UNIT III Crop modeling methods for crop-weather interaction, climate change and variability components.

UNIT IV Potential production: leaf and canopy CO₂ assimilation, respiration, dry matter accumulation, crop phenology and dry matter distribution and development in different crops.

UNIT V Production by moisture availability ,potential evapotranspiration, water balance of the soil, and production with nutrient and moisture limitations.

UNIT VI Practical on Simulation of elementary models for crop growth, Simulation of potential, production, Simulation with limitations of water and nutrient management options, Sensitivity analysis using different climatic years and crop management practices

ADVANCES IN CROP GROWTH AND PRODUCTIVITY 6 Credits/100 Marks

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.

UNIT V Source-sink relationships. Translocation of photosynthates and factors influencing transport of sucrose. Physiological and molecular control of sink activity – partitioning efficiency and harvest index. Crop growth models-empirical models testing and yield prediction.

UNIT VI Practical on 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; Measurement of light interception, light extinction coefficient, energy utilization efficiency based energy intercepted, and realized; 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

ADVANCES IN SOIL FERTILITY MANAGEMENT 6 Credits/100 Marks

UNIT I Modern concepts of nutrient availability; nutrient response functions and availability indices. Importance of root morphology in nutrient availability.

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

UNIT III Chemical equilibria (including solid-solution equilibria) involving nutrient ions in soils, particularly in submerged soils.

UNIT IV Modern concepts of fertilizer evaluation, nutrient use efficiency and nutrient budgeting.

UNIT V Modern concepts in fertilizer application; soil fertility evaluation techniques; role of soil tests in fertilizer recommendations; site-specific nutrient management for precision agriculture, Use of SPAD chlorophyll meter and LCC as tools of fertilizer N management.

UNIT VI 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 effect of fertilizer use.

UNIT VII Fertilizer use in problem soils; Fertilizers and environmental pollution; Soil health and quality; phytoremediation.

UNIT VIII Practical on Design of soil fertility experiments; Collection and processing of soil and plant samples for nutrient analysis; Handling of common laboratory equipments used for soil and plant sample analysis; Analysis of soil samples for soil pH, organic carbon, available nitrogen, available phosphorus, available sulphur, lime requirement, electrical conductivity; Analysis of plant samples for nitrogen, phosphorus, potassium and sulphur; Soil fertility experimental data analysis and interpretations; Correlation and regression studies of plant nutrient and crop growth and yield; Determination of soil biomass carbon; Determination of micronutrients in soils and plants by AAS; Visit to long term fertilizer experiment stations.

ADVANCES IN IRRIGATION MANAGEMENT 6 Credits/100 Marks

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.

UNIT II Soil-plant-water relationships, transpiration and evapotranspiration, significance of transpiration, energy utilization in transpiration, physiological process and crop productivity.

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

UNIT IV Application of irrigation water, conveyance and distribution system, irrigation efficiency; agronomic considerations in design and operation of irrigation projects; irrigation management in principal crops and cropping system; quality of irrigation water and management of saline water for crop production.

UNIT V Strategies of using limited water supply; factors affecting ET, control of ET by mulching and use of anti-transpirations; fertilizer use in relation to irrigation; optimizing the use of given irrigation supplies.

UNIT VI Land suitability for irrigation, land irrigability classification; integrated water management in command areas, farmer's participation in command areas, irrigation legislation.

UNIT VII Practical on Determination of water infiltration characteristics and water holding capacity of soil profiles; Moisture extraction pattern of crops; Consumptive use, water requirement of a given cropping pattern for optimum / variable productivity; Crop planning at the farm and project level; Agronomic evaluation of irrigation projects, case studies.

ADVANCES IN WEED MANAGEMENT 6 Credits/100 Marks

UNIT I Crop weed competition in different cropping situations; changes in weed flora, various causes and effects; integrated weed management in major cropping systems.

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

UNIT III Climatic factors and phytotoxicity of herbicides; fate of herbicides in soil and factors affecting them, residue management of herbicides; adjuvants.

UNIT IV Advances in herbicide application techniques; antidotes and crop protection; compatibility of herbicides of different groups; compatibility of herbicides with other pesticides, herbicide development, registration procedures.

UNIT V Recent advances in herbicide resistance in weed and its management; development of transgenic herbicide resistant crops; invasive weeds, aquatic and parasitic weeds and their management; advances in weed utilization

UNIT VI Relationship of herbicides with tillage, fertilizer and irrigation; bio-herbicides and herbal herbicides, allelochemicals, herbicide bioassays.

UNIT VII Practical on Phytosociological analysis of weed flora in major cropping system; Studies on propagule production potential of major weeds; Determination of critical period of crop weed competition; Studies on mode of action of herbicides; Economic utilization of weeds; Herbicide bioassays.

INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE

6 Credits/100 Marks

UNIT I Farming systems: definition, concept and scope; Components of farming systems in plains and hills; classification of farming systems according to type of rotation, intensity of rotation, degree of commercialization and mechanization, water supply, enterprises. Integrated farming systems.

UNIT II Concept of sustainability in farming systems; efficient farming systems; natural resources - identification and management.

UNIT III Production potential of different components of farming systems; interaction and mechanism of different production factors; stability in different systems through research; eco-physiological approaches to intercropping.

UNIT IV Simulation models for cropping systems; agronomic management in different cropping systems; preparation of different farming system models; evaluation of different farming systems. UNIT V New concepts and approaches of farming systems and cropping systems and organic farming; case studies on different farming systems.

SOIL CONSERVATION AND WATERSHED MANAGEMENT 6 Credits/100 Marks

UNIT I Soil erosion: definition, nature and extent of erosion; types of erosion, factors affecting erosion.

UNIT II Soil conservation: definition, methods of soil conservation; agronomic measures - contour cultivation, strip cropping, cover crops; vegetative barriers; improved dry farming practices; contingent crop planning; mechanical measures - bunding, gully control, bench terracing; role of grasses and pastures in soil conservation; wind breaks and shelter belts.

UNIT III Watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping systems for watershed areas. Farming systems in watershed areas.

UNIT IV Land use capability classification, alternate land use systems; agro-forestry; ley farming; jhum management - basic concepts, Drainage and agronomic management; Measures to prevent soil erosion.

UNIT V Practical on Study of different types of erosion; Field studies of different soil conservation measures; Run-off and soil loss measurements; Laying out run-off plot and deciding treatments; Identification of different grasses and trees for soil conservation; Visit to a soil conservation research centre, demonstration and training centre.

STRESS CROP PRODUCTION

6 Credits/100 Marks

UNIT I Stress and strain terminology; nature and stress injury and resistance; causes of stress, Response of plants to abiotic stresses: Abiotic stresses affecting plant productivity.

UNIT II Low temperature stress: freezing injury and resistance in plants, measurement of freezing tolerance, chilling injury and resistance in plants, Tolerance mechanism-crucial role of membrane lipids, practical ways to overcome the effect 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, Tolerance mechanisms- role of membrane lipids and HSPs, practical ways to overcome the effect of heat stress through soil and crop manipulations.

UNIT IV Water deficit stress: meaning of plant water deficient stress and its effect on growth and development, water deficit injury and resistance, practical ways to overcome effect of water deficit stress through soil and crop, manipulations.

UNIT V Excess water or flooding stress: meaning of excess water stress, its kinds and effects on crop plants, excess water stress injury and resistance, practical ways to overcome excess

water stress through soil and crop manipulations.

UNIT VI Salt stress: meaning of salt stress and its effect on crop growth, salt stress injury and resistance in plants, practical ways to overcome the effect of salt stress through soil and crop manipulations.

UNIT VII Environmental pollution: air, soil and water pollution, and their effect on crop growth and quality of produce; ways and means to prevent environmental pollution. Heavy metal stress: Aluminum and cadmium toxicity in acid soils. Role of Phytochelatins (heavy metal binding proteins).

UNIT VIII Practical on Determination of electrical conductivity of plant cell sap and soil water; Determination of osmotic potential and tissue water potential; Measurement of transpiration rate; Measurement of stomatal frequency; Determination of proline content of plant parts; Determination of Relative Leaf water content of plants; Quantification of anti oxidative enzymes like Super oxide desmutase (SOD); Determination of membrane injury index(MII); Determination of chlorophyll stability index (CSI); Studying the role of growth regulators in amelioration of abiotic stress effects in plants; Determination of soil water potential and content by psychrometry and other systems; Studies on effect of osmotic and ionic stress on seed germination and seedling growth