SCHEME OF INSTRUCTION AND SYLLABUS

Agriculture and Allied Science

Regulation:

w.e.f. 2024-25

विद्या कल्पलतेव

Faculty of Agriculture and Allied Science

United University

Rawatpur-Jhalwa (Prayagraj)

Uttar Pradesh

University Vision

To established a Value based Global University having dynamic learning environment encouraging creativity and innovation, research inspired experimental learning and focusing on topics that are pertinent to the development of the region, the Country and the World.

University Mission

- To provide a dynamic, inspiring, and varied learning environment with global exposure.
- To position the institution as a premier hub for research and experiential learning.
- To develop into an adaptable university meeting the demands of society and business.
- To incorporate Value thinking, integrity, wisdom and passion in professional for their career and life.

Department Vision

- To establish a preeminent role in advancing education, extension activities, and research within the field of agriculture.
- To cultivate a dynamic environment that nurtures entrepreneurial endeavours generates job opportunities, and develops a skilled workforce proficient in agricultural practices.
- To improve the quality and effectiveness of agricultural practices through strategic public-private partnerships.
- To contribute to the economic development of society and the nation by leveraging innovative agricultural strategies and collaborations.

Department Mission

- To provide a rigorous and comprehensive education in agricultural sciences, equipping students with advanced knowledge, critical thinking skills, and practical experience.
- To conduct and promote high-impact research that addresses contemporary challenges in agriculture fosters innovation, and advances scientific understanding.
- To engage with local, regional, and global communities through extension programs that disseminate knowledge, provide practical solutions, and support sustainable agricultural practices.
- To support and inspire entrepreneurship in agriculture by offering resources, mentorship, and opportunities that encourage the creation of new ventures and job prospects.

Program Educational Objectives

(Post graduate)

PEOs-1: Students will be able to exhibit comprehension and knowledge of key ideas, concepts, and theories pertaining to the agronomic field

PEOs2: Developing the ability to understand, look into, comprehend, and evaluate complicated issues related to agronomic practices in order to find workable solutions and implementation plans.

PEOs-3: Assess the scientific and analytical decision-making process with research instruments and cross-functional data.

PEOs-4: Emphasize the importance of research in creating and preserving knowledge of the most advanced technology in the agricultural industry. Learn how to create, develop, and adapt systems to satisfy specific requirements while staying within reasonable bounds.

PEOs-5: Recognize how to establish and run profitable business endeavours.

PEOs-6 Put ethical ideas into practice, adhere to professional obligations and scientific practice norms, and familiarize yourself with laws, standards, and intellectual property rights.

Program Outcomes

On successful completion of the M.Sc. Ag programme the student will be able to:

PO1. Building In-depth caliber in multiple fields related to Agriculture and Allied Sector.

PO2. Develop understanding of the topic and to work enhance the farmer's circumstances their contributions in the in different sectors of society.

PO3 Develop profound understanding of soil, fertilizers, livestock insects, and cultivation techniques economic pest connected to agricultural businesses.

PO4: Make decisions using suitable scientific and statistical techniques and assessments producing in several agricultural fields.

PO5: Implicate deep knowledge and understanding to produce high output in a range of agricultural products for development of country and world

Program Specific Outcomes

PSO1:

Use communication abilities both orally and in writing.

PSO2:

Being familiar with the fundamental ideas, and theories of agronomy.

PSO3:

Conducts research, teaches, and provides administrative and consulting services to businesses related to agriculture sector.

PSO4:

Use knowledge and research to solve or offer solutions for issues facing the agriculture sector

SCHEME OF INSTRUCTION

Semester I							
Contact Hours							31
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	AGPCMG101T	M.Sc. Agronomy	Principles & Practices of Weed Management	2	0	0	2
2	AGPCMG102T	M.Sc. Agronomy	Research Methodology	2	0	0	2
3	AGPCMG103T	M.Sc. Agronomy	Principles & Practices of Soil Fertility & Nutrient Management	2	0	0	2
4	AGPCMG104T	M.Sc. Agronomy	Experimental Design	2	0	0	2
5	AGPCMG105T	M.Sc. Agronomy	Modern Concepts in Crop Production	3	0	0	3
6	AGPCMG106T	M.Sc. Agronomy	Disaster Management	1	0	0	1
7	AGPCMG107P	M.Sc. Agronomy	Master's Seminar-I	0	0	2	1
8	CASAGMA10T	M.Sc. Agronomy	Fundamentals of Computer & Applications	3	0	0	3
9	PTSPMMG10T	M.Sc. Agronomy	Professional Proficiency (M.Sc. Ag.)-I	4	0	0	4
10	AGPCMG101P	M.Sc. Agronomy	Principles & Practices of Weed Management Practical	0	0	2	1
11	AGPCMG102P	M.Sc. Agronomy	Research Methodology Practical	0	0	2	1
12	AGPCMG103P	M.Sc. Agronomy	Principles & Practices of Soil Fertility & Nutrient Management Practical	0	0	2	1
13	AGPCMG104P	M.Sc. Agronomy	Experimental Design Practical	0	0	2	1
14	CASAGMA10P	M.Sc. Agronomy	Fundamentals of Computer & Applications Practical	0	0	2	1
15	PTSPMMG20P	M.Sc. Agronomy	Technical Writing and Communication Skills	0	0	2	1
							26

Semester II

Contact Hours							28
S.No.	Course Code	Course Category	Course Name	L	T	P	C
1	AGPCMG201T	M.Sc. Agronomy	Agronomy of Major Cereals and Pulses	2	0	0	2
2	AGPCMG202T	M.Sc. Agronomy	Agronomy of Oilseed, Fibre and Sugar Crop2	2	0	0	2
3	AGPCMG203T	M.Sc. Agronomy	Agronomy of Medicinal, Aromatic and Under- utilized Cr	2	0	0	2
4	AGPCMG204T	M.Sc. Agronomy	Agrometeorology & Crop Weather Forecasting	2	0	0	2
5	AGPCMG205T	M.Sc. Agronomy	Soil Fertility and Plant Nutrition	2	0	0	2
6	AGPCMG206T	M.Sc. Agronomy	Principles and Practices of Water Management	2	0	0	2
7	AGPCMG207P	M.Sc. Agronomy	Master's Research (Synopsis Presentation)	0	0	2	5
8	PTSPMMG20T	M.Sc. Agronomy	Professional Proficiency (M.Sc. Ag)	2	0	0	2
9	AGPCMG201P	M.Sc. Agronomy	Agronomy of Major Cereals and Pulse Practical	0	0	2	1
10	AGPCMG202P	M.Sc. Agronomy	Agronomy of Oilseed, Fibre and Sugar Crops Practical	0	0	2	1
11	AGPCMG203P	M.Sc. Agronomy	Agronomy of Medicinal, Aromatic and Under- utilized Crops Practical	0	0	2	1
12	AGPCMG204P	M.Sc. Agronomy	Agro-meteorology & Crop Weather Forecasting Practical	0	0	2	1
13	AGPCMG205P	M.Sc. Agronomy	Soil Fertility and Plant Nutrition Practical	0	0	2	1
14	AGPCMG206P	M.Sc. Agronomy	Principles and Practices of Water Management Practical	0	0	2	1
15	AGPCMG208P	M.Sc. Agronomy	Basic Concepts in Laboratory Techniques Practical	0	0	2	1
							26

Semester III

Contact Hours							35
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1.	**AGPCMG301T**	Theory	Agronomy of Fodder & Forage Crops	2	0	0	2
2.	**AGPCMG302T**	Theory	Cropping Systems & Sustainable Agriculture	2	0	0	2
3.	**AGPCMG303T**	Theory	Dryland Farming & Watershed Management	2	0	0	2
4.	**AGPCMG304T**	Theory	Principles & Practices of Organic Farming	2	0	0	2
5.	**AGPCMG315T**	Theory	Agrostology and Agroforestry	1	0	0	1
6.	**AGPCMG306T**	Theory	Intellectual Property and its Management in Agriculture	1	0	0	1
7.	**AGPCMG307T**	Theory	Agricultural Research, Research Ethics and Rural Development Programs	1	0	0	1
8.	**PTSPMMG30T**	Theory	Professional Proficiency (M.Sc. Ag.)-III	3	0	0	2
9.	**AGPCMG308P**	Practical	Master's Seminar-II	0	0	2	1
10	***AGPCMG309P***	Practical	Master's Research (Dissertation Work)	0	0	5	*5*
11	**AGPCMG310P**	Practical	Library and Information Services	0	0	2	1
12	**AGPCMG301P**	Practical	Agronomy of Fodder & Forage Crops Practical	0	0	2	1
13	**AGPCMG302P**	Practical	Cropping Systems & Sustainable Agriculture Practical	0	0	2	1
14	**AGPCMG303P**	Practical	Dryland Farming & Watershed Management Practical	0	0	2	1
15	**AGPCMG304P**	Practical	Principles & Practices of Organic Farming	0	0	2	1
16	**AGPCMG305P**	Practical	Agrostology and Agroforestry Practical	0	0	2	1
17	**AGPCMG311P**	Practical	Excursion Visit (Agro-Industry)	0	0	2	1
							26

Semester IV							
Contact Hours							5
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1.	**AGPCMG309P**	Practical	**MASTER'S RESEARCH (DISSERTATION WORK)**	0	0	5	20
			Total				20

Note:

1 The student should undergo for master research-simultaneously he/she should work on a project with well-defined objectives.

2 At the end of the IV semester the student should submit a thesis completion certificate and a Hard copy of thesis.

3 This is incorporated to enhance student Research skills and employability in cutting edge technologies of modern Agriculture.

SUBJECT CODE & NAME: AGPCMG101T / PRINCIPLES AND PRACTICES OF WEED MANAGEMENT

COURSE OUTCOMES

1. Student will be able to understand the weed biology, and concept of weed control along with its classification and herbicides.
2. Student will be able to understand the mechanism of herbicides, herbicide formulations along with herbicide resistance in to the plant.
3. Student will be able to understand the concept of herbicide in weed control along with herbicides resistance in weed and crops.
4. Student will be able to understand the parasitic weed, aquatic weed and perennial weed in addition to integrated weed management and able to analysis of cost benefit.

UNIT I:

Crop weed competition and Weed control:

Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices. Herbicide introduction and history of their development; classification based on chemical, physiological application and selectivity.

UNIT II:

Herbicide structure and resistance:

Mode and mechanism of action of herbicides. Herbicide structure-activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management.

UNIT III:

Bio-herbicide

Weed control through bio-herbicides, myco-herbicides and allelochemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.

UNIT IV:

Integrated weed management:

Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control. Integrated weed management; cost: benefit analysis of weed management.

TEXTBOOKS

1. Weed Management Hand Book- Naylor. 2002. Blackwell Publishing.
2. Principles in Weed Management- RJ Aldrich & RJ Kramer. 1997. Panima Publ. corporation.
3. Modern Weed Management- OP. Gupta. 2008. Agrobios.
4. Weed Management- VN Sarswat, VM Bhan & NT. Yaduraju. 2003. ICAR.
5. Fundamentals of Weed Science- RL. Zimdahl. 1999. 2nd Ed. Academic Press.
6. Mode of Action of Herbicides- FM Ashton & AS Crafts. 1981. 2nd Ed. Wiley Inter-Science.
7. Principles of Weed Science- VS Rao. 2000. Oxford & IBH.
8. Sustainable Weed Management- HP Singh, DR Batish & RK Kohli. 2006. Food Products Press - An imprint of The Haworth Press Inc.
9. Herbicide Bioassay- JC Streibig & P Kudsk. 1993. CRC Press Inc.

REFERENCE BOOKS

1. Weed Management by O.P. Gupta.
2. A Textbook of Weed Management by S. S. Lather and V. C. Srivastava.
3. Weed Science and Weed Management in Rice and Wheat Cropping Systems by M. Singh, B. Singh, and S. Sharma.
4. Weed Identification and Management Manual by ICAR-DWR (Directorate of Weed Research), Jabalpur.
5. Principles of Weed Science by V.S. Mani.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Weed Science: Principles and Practices by Thomas J. Monaco, Stephen C. Weller, and Floyd M. Ashton.
2. Integrated Weed Management for Sustainable Agriculture by Robert Zimdahl.
3. Weed Ecology in Natural and Agricultural Systems by Barbara D. Booth and Stephen D. Murphy.
4. Herbicides: Current Research and Case Studies in Use by Andrew Price and Jessica Kelton.
5. Biological Control of Weeds: A World Catalogue of Agents and Their Target Weeds by R.G. van Driesche, M.S. Hoddle, and T.D. Center.

SUBJECT CODE & NAME: AGPCMG101P / PRINCIPLES AND PRACTICES OF WEED MANAGEMENT

Course Outcomes

1. Skilled on identification of important weed plant along with preparation of weed herbarium.
2. Student will be able to understand the concept of weed survey in different crops along with the crop weed competition.
3. Skilled on preparation of spray solution of herbicides for sprayers with uses of various types of nozzles and sprayers.
4. Study the economics of weed control and skilled on herbicide resistance analysis with calculation of herbicide requirement.

Objectives: -

1. **Identification of important weeds of different crops:** Common name (English/ Local), Scientific name, Group, Family, Salient characteristics.
2. **Preparation of a weed herbarium:** Collection of weed sample, Pressing and drying of collected specimen, Poisoning, Mounting on herbarium sheet, Preparation and fixing of identification label, Preservation.
3. **Weed survey in crops and cropping systems:** Conveyance to visit area, Site, 10 minimal sample area , Size 0.5 m x 0.5 m or 1.0 m x 1.0, Quadrat, Calculate % occurrence of weeds.
4. **Crop-weed competition studies**: Concept, Component of the overall competitive effect, Competition for nutrients, Competition for light, Competition for Moisture, Factors affected crop weed competition.
5. **Preparation of spray solutions of herbicides for high and low-volume sprayers:** Dose calculations, Field crops, Aquatic weeds, Rectangular water bodies, For Spherical water bodies, Flowing canals or channels.
6. **Use of various types of spray pumps and nozzles and calculation of swath width:** Manually operated, Compressed air sprayer, Hydraulic sprayer, Power operated, Hand atomizer, Bucket type, Knapsack, Boom-type field sprayers, Field sprayer calibration, Nozzles; Flat fan, Flood jet, Cone.
7. **Economics of weed control:** Cost of cultivation, Gross returns, Net returns, Net returns per rupee invested, Cost of weed control, Gross return due to weed control, Net return due to weed control.
8. **Herbicide resistance analysis in plant and soil:** Resistant weed, Prevent seed production, Moving seed or Vegetative propagules.

9. **Bioassay of herbicide resistance, Calculation of herbicidal requirement:** Time of Application, Concentration of herbicides, Formulation of Herbicides, Method of Application, Calculating Proper Quantities of Herbicides, Acid Equivalent.

LABORATORY MANUAL

1. ICAR-DWR. (Year). **Weed Management Laboratory Manual**. Directorate of Weed Research, Jabalpur.
2. Choudhary, V.P., & Bhan, S.K. (Year). **Practical Manual on Weed Management**. ICAR Publication.
3. Malik, R.K., Singh, T., & Yadav, M. (Year). **Weed Science and Weed Management Lab Manual**. ICAR Publication.
4. Mahesh, G., Singh, S., & Kumar, P. (Year). **Integrated Weed Management: Practical Manual**. ICAR Publication.
5. Tewari, N., & Chauhan, R. (Year). **Lab Manual on Weed Identification and Herbicide Usage**. ICAR Publication.

SUBJECT CODE & NAME: AGPCMG102T / RESEARCH METHODOLOGY

COURSE OUTCOMES

1. Understand the basic concept of research, research problems along with the parameters and approaches of research.
2. Student will be able on data collection and its others aspects with their schedule and measurement of variables in agriculture.
3. Skilled on survey of agriculture i.e. interviewing techniques, problems with sampling of design and methods of sampling.
4. Student will be skilled on design of research, its type and able on preparing research report with improved skills of writing research articles.

UNIT: I

Scope of research and Approach to research: Importance and scope of research in agricultural economics. Types of research- Fundamental vs. Applied. Concept of researchable problem– research prioritization– selection of research problem. Approach to research– research process.

UNIT: II

Data collection and Measurement of Variables: Data collection– assessment of data needs– sources of data collection– discussion of different situations. Mailed questionnaire and interview schedule– structured, unstructured, open ended and closed-ended questions. Scaling Techniques. Preparation of schedule– problems in measurement of variables in agriculture.

UNIT: III

Survey and Sampling: Interviewing techniques and field problems- methods of conducting survey– Reconnaissance survey and Pre testing. Sampling theory and sampling design– sampling error- methods of sampling– probability and non-probability sampling methods- criteria to choose.

UNIT IV:

Research design and Hypothesis: Project proposals- contents and scope- different types of project to meet different needs- trade-off between scope and cost of the study. Research design and techniques– Types of research design. Hypothesis– meaning- characteristics- types of hypothesis– review of literature– setting of Course Objective and hypotheses- testing of hypothesis. Coding editing- tabulation- validation of data. Tools of analysis- data processing.

Interpretation of results- Preparing research report/ thesis– Universal procedures for preparation of bibliography– writing of research articles.

Text Books

1. Research Methodology- Methods and Techniques- CR. Kothari. 2004. Wishwa Prakashan, Chennai.
2. Introduction to Research Methodology in Agricultural and Biological Sciences- V. Venkatasubramanian.
3. 1999. SAGE Publ.
4. Research Design- Qualitative and Quantitative Approaches- JW. Creswell. 1999. SAGE Publ.
5. Research Methodology in Social Sciences and Essentials of Thesis Writing- SP. Dhondyal. 1997.
6. Amman Publ. House, New Delhi.
7. Research Methodology in Commerce and Management- KV. Rao. 1993. Sterling Publ., New Delhi.
8. Tests, Measurements and Research Methods in Behavioural Sciences- AK. Singh. 1993. Tata McGraw- Hill.
9. Evaluating Social Science Research- An Introduction- TR. Black. 1993. SAGE Publ.

Reference Books

1. "Research Methodology in Applied Economics" by Don E. Ethridge. Wiley-Blackwell. 2004
2. "Methods of Data Collection in Agricultural Economics" by B.C. Agrawal. Concept Publishing Company.1989
3. "Research Methodology: Methods and Techniques" by C.R. Kothari. New Age International Publishers. 2004
4. "Principles of Agricultural Economics" by Andrew Barkley and Paul W. Barkley. Routledge.2016
5. "Sampling Techniques" by William G. Cochran. Wiley.1977

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar. SAGE Publications. 2014 (4th Edition, available in e-book format).
2. **"Agricultural Economics and Agribusiness"** by Gail L. Cramer, Clarence W. Jensen, and Douglas D. Southgate. Wiley. Multiple editions (e-book versions available)
3. **"Sampling of Populations: Methods and Applications"** by Paul S. Levy and Stanley Lemeshow. Wiley. 2013 (4th Edition, e-book available)

SUBJECT CODE & NAME: AGPCMG102P / RESEARCH METHODOLOGY

COURSE OUTCOMES

1. Skilled on problem identification of research with preparation of project proposal result.
2. Understand the formulation of primary and secondary objective along with characteristics and collection of data with their sources.
3. Student will be skilled on sampling methods under different situation and interview schedule along with conducting agriculture based survey work.
4. Skilled on writing of thesis, data entry and hypothesis of research work in addition with result presentation.

Objectives: -

1. **Exercises in problem identification:** Types of research Problem, Sources of Problems, Formulation of Research Questions, Multiple Perspective, Research ability, Characteristics of research question, Feasible, Ethical.
2. **Project proposals– contents and scope**: Statements, Introduction / Problem Statement, Objectives, Work Plan, Basic Research, Applied Research, Test and Evaluation, Anticipated Benefits, Implementation, Expected Deliverables, Time Schedule, Literature Cited, References, Budget, Justification.
3. **Formulation of objective and hypotheses:** Operationalized study, Primary and Secondary objectives, Prioritize (limit) objectives, Active language, Characteristics, sample size calculation, Appropriate design, Analysis.
4. **Assessment of data needs– sources of data– methods of collection of data:** Operational Questions, Need based on questions, Feed the data, Good metric for determining, Approaches to data collection.
5. **Methods of sampling– criteria to choose– discussion on sampling under different situations:** Probability sampling, non-probability sampling, Types of probability sampling, Four types of probability sampling techniques, Uses of probability sampling, Types of non-probability sampling, Uses of non-probability sampling.
6. Scaling Techniques measurement of scales: Four levels of measurements; Nominal, Ordinal, Interval, Ratio.
7. **Preparation of interview schedule- Field testing. Method of conducting survey:** The opening, The body; The closing, Identify the audience, Survey provider, Conduct the survey, Context for the survey, Evaluate research.
8. Exercise on coding, editing, tabulation and validation of data: Survey Management, Data Capture, Data Review, Data Adjustment. Rules of tabulation, Ideal Table, Simple tabulation, Double tabulation, Complex tabulation.
9. **Preparing for data entry into computer:** Logging the Data, mail surveys returns, Coded interview data, Pretest or posttest data, Observational data, Checking the Data For

Accuracy, Database Structure, Data Transformations, Missing values, Item reversals, Scale totals.

10. **Hypothesis testing- Parametric and Non- Parametric Tests:** Normal distribution, Curve, Mean, Standard deviation, Variance of the data. Null hypothesis, Nominal and ordinal data, Quantitative data, Distribution curve.
11. **Exercises on format for Thesis / Report writing** : Working with Assigned Topics, Standard title, Abstract, Research problem, Methodology, Key results, Conclusion, Table of contents, List of figures, List of tables.
12. **Presentation of the results:** Three main formats: Oral presentation, Poster presentation, Written paper, Introduction, Materials and Methods, Results, Discussion, Acknowledgments.

LAB MANUAL:

1. Research Methodology: Practical Manual by ICAR - Covers practical exercises on designing experiments, data collection, and analysis techniques.
2. Laboratory Manual for Research Methods in Social Sciences by P. Kumar - Provides hands-on training for research design, sampling methods, and statistical analysis.
3. Practical Manual on Research Methodology in Agriculture by R.K. Gupta - Focuses on agricultural research techniques, experimental design, and data handling.
4. Research Methodology Lab Manual by S. Sharma - Offers step-by-step guidance on qualitative and quantitative research methods with practical examples.
5. Research Techniques in Biological Sciences: A Lab Manual by A. Tiwari - Includes protocols for biological research, data analysis, and report writing.

SUBJECT CODE & NAME: AGPCMG103T / PRINCIPLES & PRACTICES OF SOIL FERTILITY & NUTRIENT MANAGEMENT

COURSE OUTCOMES

1. Student will be understanding the concept of fertility and productivity of soil and crop growth with their factors affecting along with concept of organic farming.
2. Study the essential crop nutrient and able to understand their function in growth of plants with preparation of organic manure and their composition.
3. Student will be able to understand the concept of recycling of organic waste, commercial fertilizers and crop response along with fertilizer use efficiency.
4. Understand the methods of fertilizer/ manure application, foliar spray with their concept and time with addition of integrated nutrient management.

UNIT: I

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

UNIT: II

Essential plant nutrients and Organic fertilizers: Criteria of essentiality of nutrients; Essential plant nutrients– their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients. Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition.

UNIT: III

Commercial fertilizers and Crop response: Availability and crop responses; recycling of organic wastes and residue management. Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades.

UNIT: IV

Methods of fertilizers application and Integrated nutrient management: Agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions. Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermicompost and residue wastes in crops.

Text Books

1. The Nature and Properties of Soils- Brady NC & Weil R.R. 2002. 13th Ed. Pearson Edu.
2. Growth and Mineral Nutrition of Field Crops- Fageria NK, Baligar VC & Jones CA. 1991. Marcel Dekker.
3. A Hand Book of Soil, Fertilizer and Manures- Gupta PK. 2007. Agribios.
4. Soil Fertility and Fertilizers. 7th Ed- Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. Prentice Hall.
5. Soil Fertility Management for Sustainable Agriculture- Prasad R & Power JF. 1997. CRC Press.
6. Efficient Use of Fertilizers- Somani LL. 1996. Agrotech Publishing Academy.
7. Manures and Fertilizers- Yawalkar KS, Agrawal JP & Bokde S. 2000. Agri Horti Publ.

Reference Books

1. "Soil Fertility and Fertilizers: An Introduction to Nutrient Management" by John L. Havlin, Samuel L. Tisdale, Werner L. Nelson, and James D. Beaton. Pearson. 2013 (8th Edition)
2. "Organic Farming: Theory and Practice" by S.P. Palaniappan and K. Annadurai. Scientific Publishers. 2017
3. "The Nature and Properties of Soils" by Raymond R. Weil and Nyle C. Brady. Pearson. 2016 (15th Edition)
4. "Principles of Soil Chemistry" by Kim H. Tan. CRC Press. 2010 (4th Edition)
5. "Integrated Nutrient Management for Sustainable Agriculture" by M. S. Yadav, R. S. Yadav, and V. P. Singh. New India Publishing Agency. 2015

E resources

1. **"Soil Fertility and Nutrient Management: An Introduction"** by Rajesh Kumar and S. P. Singh**.** New India Publishing Agency**.** 2019
2. **"Soil Fertility Management for Sustainable Agriculture"** by James F. Power and Rajendra Prasad**.** CRC Press**.** 1997**.** CRCnetBASE and academic libraries.
3. **"Principles of Soil Chemistry"** by Kim H. Tan**.** CRC Press**.** 2010 (4th Edition)

SUBJECT CODE & NAME: AGPCMG103P / PRINCIPLES & PRACTICES OF SOIL FERTILITY & NUTRIENT MANAGEMENT

COURSE OUTCOMES

1. Skilled on determination of soil pH, soil EC and organic carbon along with total available nitrogen in soil as per recommended scientific methods.
2. Student will be able to determine the available NPK and Sulphar in soil.
3. Skilled on determination of total NPK and Sulphar available in plants by recommended methods along with its nutrient interaction effect and yield optima.

1. **Determination of soil Ph:** Reagents; Buffer Solution of pH 4.0, 7.0 and 9.2, Distilled water, Reagents, Soil to water ratio 1:2, Saturates soil paste, Saturation extract.
2. **Determination of soil EC:** Potassium chloride, Distilled water, Soil sample, Conductivity meter.
3. **Determination of soil organic Carbon:** Walkley- Black Method, Reagents, 2.00 g dried soil, K2Cr2O7, H2SO4, Water, H3PO4 or NaF, Ferroin indicator, Calculate % organic C and % organic matter.
4. **Determination of soil total Nitrogen:** Catalyst mixture, Potassium sulphate, Copper sulphate and selenium powder (ratio 50:10:1), Sodium hydroxide, Boric acid, Mixed indicator and sulphuric acid, Digestion, Distillation and titration.
5. **Determination of available N,P, K in soil:** Reagent: KMnO4 solution, NaOH solution, H2SO4, Methyl red indicator, Procedure, Observation. Colorimetric measurement, Reagent, Sodium bicarbonate solution, Activated charcoal, Sulphuric acid solution, Reagent A, Reagent B, Phosphate Solution, Standard curve. Reagent, Neutral normal ammonium acetate, Standard potassium solution, Preparation of standard curve, Wet digestion, Determination of K. spectrophotometer and flame-photometer.
6. **Determination of Sulphur in soils Reagents;** Mono-calcium phosphate, Gum acacia acetic acid, Barium chloride, Stock solution, Barium sulphate, Procedure, Turbidimetric method, Standard curve, Digestion of plant material, Estimation.
7. **Determination of total N, P, K and S in plants**: Micro Kjeldahl method, Procedure, Digestion, Distillation, Titration, Crude protein content, Standard curve, Turbidimetric method.
8. **Interpretation of interaction effects and computation of economic and yield optima:** Two or more growth factors, Positive interaction (Liebig's law of the minimum), Negative interactions (Lime x P, lime x Mo, Mo x P, and Na x K), No interaction, Interpretation, Exercises, Solution.

Lab Manual:

1. "Laboratory Manual on Soil Fertility and Nutrient Management" by Dr. S.K. Gupta and Dr. S.P. Singh Publication: ICAR, New Delhi
2. "Field and Laboratory Manual for Soil Fertility and Nutrient Management" by Dr. M.K. Yadav and Dr. R. Ramesh Publication: ICAR, New Delhi
3. "Soil Fertility and Fertilizers: An Introduction to Nutrient Management" by John L. Havlin et al.
4. "Soil Testing and Plant Analysis" by R. L. Westerman

SUBJECT CODE & NAME: AGPCMG104T / EXPERIMENTAL DESIGN

COURSE OUTCOMES

1. Understand the analysis of variance with definition and assumption along with one way classification and two way classifications.
2. Understand the basic of sampling with their trials and probability along with efficiency of different types of sampling.
3. Student will be able to work on design of experiment with Randomized block design, Latin square design, factorial experiments and their relationship between factors affecting a process and the output of that process.
4. Understand the split plot design and its uses in agriculture field along with two levels of experimental units and their sub plot experimental units.

UNIT: I

Analysis of Variance: Analysis of variance: Definition and assumptions, one way classification, two-way classification.

UNIT: II

Sampling Techniques: Sampling Techniques: Simple random sampling, stratified random sampling, systematic sampling.

UNIT: III

Design Experiments: Design Experiments: Randomized Block design, Latin Square design, Factorial design (22, 23, 32, 33

factorials).

UNIT: IV

Split Plot Experiments: Some P x Q experiments, Split Plot Experiments. Balanced Incomplete Block design.

Text Books

1. Statistical Procedures for Agricultural Research- K.A. Gomez and A.A. Gomez. 1984. John Wiley and Sons.
2. Principles and Procedures of Statistics- R.G.D. Steel and J.H. Torrie. 1960. McGraw – Hill Book Co., New Delhi.
3. Statistical Methods for Agricultural Workers- V.G. Panse and P.V. Sukhtame. 1985. ICAR, New Delhi.

4. Experimental Designs- W.G. Cochran and G.M.Cox.1957. A Wiley International Edition. Canada.

Reference Books

1. Design and Analysis of Experiments- Dean AM & Voss D. 1999. Springer. Federer WT. 1985. Experimental Designs. MacMillan.
2. Design and Analysis of Experiments- Fisher RA. 1953. Oliver & Boyd.
3. Handbook on Analysis of Agricultural Experiments- Nigam AK & Gupta VK. 1979. IASRI Publ.
4. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice- Pearce SC. 1983. John Wileg & Sons.

E resources

1. **Coursera**: Courses like *Design and Interpretation of Clinical Trials* (which often includes experimental design principles).
2. **EdX**: Courses on statistics and experimental design.
3. **FAO e-learning Academy**: Modules on experimental design, particularly in agricultural research.

SUBJECT CODE & NAME: AGPCMG104P / EXPERIMENTAL DESIGN

COURSE OUTCOMES

1. Understand the basic of RBD with designing, observation/ measurement and analysis of data with factorial experiments.
2. Understand the three grouping factors and three way analysis, interaction along with symmetrical and asymmetrical factorial experiments.
3. Study the advantages and disadvanges of confounding along with missing plot techniques in RBD & LSD with one observation missing.
4. Student will be able to understand the split plot design and ANOVA with data analysis, covariance in RBD and its transformation.

Objectives: -

1. **Analysis of variance:** Introduction to ANOVA, Terminologies, One-way ANOVA, Two-way ANOVA, MANOVA.
2. **Randomized Block Design:** Layout of the Experiment, Analysis, Model, ANOVA Table.
3. **Analysis of 2^2 and 2^3 experiments in R.B.D:** Two factors, Two levels, Total number of treatment combinations, R.B.D., Three factors, Two levels, Replication, Layout of experiment, Analysis.
4. **Analysis of AxB factorial experiments:** Factor, Level, arrangement, Simple Effects, Main Effects, Interactions, ANOVA for a 2x2 Factorial.
5. **Analysis of AxBxC factorial experiments:** Three grouping factors, Independent variables, Dependent variable, Three way interaction, Analysis of Variance.
6. **Complete confounding in case of 2^3 experiments:** Introduction, Factorial experiments, Symmetrical factorial experiments, Asymmetrical factorial experiments, Steps of Analysis. Experiments of factor each at three levels.
7. **Partial confounding in case of 2^3 experiments:** Treatment Combination, Normal Probability Plot, Variance Table, Interaction Plot, Balance Incomplete Block Design.
8. **Missing plot analysis in case of R.B.D:** One Missing Plot, Two Missing Plots, ANOVA Table, Suitability of RBD, Advantages and Disadvantages of RBD.
9. **Missing plot analysis in case of L.S.D. with one observation missing:** Experimental design, Incomplete Latin square, ANOVA, General linear model.
10. **Analysis of Split plot and Strip plot design:** Introduction, Degree of precision, Relative size of the main effect, Management practices, Model, Analysis, ANOVA, Introduction, Randomization and Layout, Model, Analysis, ANOVA, Standard errors, Critical differences.
11. **Analysis of Covariance in case of R.B.D:** ANOVA tables, independent variable or covariate, Dependent variable, F-test, Calculate sums, Analysis of Covariance table.

12. **Use of data transformations:** Box-Cox transformations, Design of experiments, Expectations, Normal probability plot, Residuals.

LAB MANUAL:

1. **"Experimental Design and Analysis" by** Dr. J. M. Mendenhall and Dr. T. Sincich. ICAR or related academic publishers
2. **"Principles of Experimental Design: A Laboratory Manual" by** Dr. R. C. Montgomery. ICAR or similar academic institutions
3. **"Statistical Methods for Experimental Design" by** Dr. P. R. Fisher and Dr. A. F. M. Willett. ICAR or university presses.
4. **"Design and Analysis of Experiments in Agriculture" by** Dr. S. K. Gupta. ICAR, New Delhi
5. **"Field and Laboratory Methods for Experimental Design" by** Dr. S. P. Singh and Dr. A. K. Joshi. ICAR or academic publishers

SUBJECT CODE & NAME: AGPCMG105T / MODERN CONCEPT IN CROP PRODUCTION

COURSE OUTCOMES

1. Study the basic principle of agronomy, field management and fertilizers.
2. Study the crop growth analysis along with yield equation and its interpretation.
3. Student will be able to understand the effect of lodging, effective uses of plant geometry along with crop modeling and soil plant relations.
4. Student will be able to understand the concept of integrated farming, organic farming and integrated nutrient management.

UNIT: I

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

UNIT: II

Plant population and Planting Geometry: Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield. Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.

UNIT: III

Organic Farming and Nutrient Management: Integrated farming systems, organic farming and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture.

Text Books

1. Modern Concepts And Advances Principles In Crop Production- SC Panda, Agrobios (India).
2. Principles of Crop Production- SR. Reddy. 2000. Kalyani Publishers.
3. Principles of Agronomy- S. Sankaran & TVS. Mudaliar. 1997. The Bangalore Printing & Publ.
4. Principles and Practices of Agronomy- SS. Singh. 2006, Kalyani Publishers.

Reference Books

1. Principles and Practices of Agronomy- P Balasubramaniyan & SP Palaniappan. 2001. Agrobios.
2. Maximizing Crop Yields- NK. Fageria. 1992. Marcel Dekker.
3. Soil Fertility and Fertilizers- JL Havlin, JD Beaton, SL Tisdale & WL Nelson. 2006. 7th Ed. Prentice Hall.
4. Principles of Genetics- Phundan Singh, Kalyani Publishers.

SUBJECT CODE & NAME: AGPCMG106T / DISASTER MANAGEMENT

COURSE OUTCOMES

1. Understand the basics of natural disaster and their types and impact on property, financial resources and injury or illness along with climate change and its impact on human being.
2. Study the anthropogenic disaster and event such as gas leaks, oil spills, nuclear meltdowns, and industrial fires transpire through human error and its impact on environment.
3. Student will be able to understand the concept of disaster management and role of community organizations, media along with administration in disaster management.

UNIT: I

Natural Disaster and Climate Change: Natural Disaster management and nature of natural disasters, Their types and effect. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depiction.

UNIT: II

Man Made Disaster and Management: Man-Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction.

UNIT: III

Role of NGOs and Administration in Disaster Management: Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community- based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Text Books

1. Disaster Management- Gupta HK. 2003. Indian National Science Academy. Orient Blackswan.
2. Textbook of Disaster Management- Dr Nitesh Kumar, Satish Serial Publishing House.
3. Disaster Management- Harsh K. Gupta, Universities Press (India) Limited.
4. Coping with Catastrophe: A Handbook of Disaster Management- Peter E. Hodgkinson, Michael Stewart, Routledge.

Reference Books

1. Disaster Management- Sharma VK, National Centre for Disaster Management, India.
2. Disaster management with special reference to uttarakhand (1st edition)- Dr. Jayant Gangrediwar. 2014.SBW Publishers.
3. Disaster Management Handbook- Jack Pinkowski, CRC Press, Taylor and Francis Group.
4. Geographic Information Systems (GIS) for Disaster Management- Brian Tomaszewski, CRC Press, Taylor and Francis Group.

SUBJECT CODE & NAME: AGPCMG107P / MASTERS SEMINAR

Objective

The aim of this seminar to explore the knowledge of students through the presentation on selected topic from field crops, crop nutrition, manure and fertilizers, Irrigation water management, weed & herbicidal management with crop rotation.

Course Syllabus (Presentation)

Soil, Tillage and Soil and water conservation, Rainfed Agriculture, watershed management, Irrigation water management, weed management, Farming System and sustainable agriculture, Organic farming, Soil fertility, manures and fertilizers, Geoinformatics, Nanotechnology for precision farming.

Reference Journal

1. Indian Journal of Agronomy. (n.d.). Retrieved from https://www.jstor.org/
2. International Journal of Agronomy & Agricultural Research. (n.d.). Retrieved from https://innspub.net/international-journal-of-agronomy-and-agricultural-research/
3. International Journal of Research in Agronomy. (n.d.). Retrieved from https://www.agronomyjournals.com/
4. Field Crops Research. (n.d.). Retrieved from https://www.sciencedirect.com/journal/field-crops-research
5. Agronomy Journal. (n.d.). Retrieved from https://www.agronomy.org/publications/journals
6. Crop Science. (n.d.). Retrieved from https://www.agronomy.org/publications/journals
7. European Journal of Agronomy. (n.d.). Retrieved from https://www.sciencedirect.com/journal/european-journal-of-agronomy
8. Journal of Agronomy and Crop Science. (n.d.). Retrieved from https://www.springernature.com/gp/researchers/campaigns/highlights/agriculture-agronomy
9. Plant and Soil. (n.d.). Retrieved from https://link.springer.com/journal/11104
10. Soil Science Society of America Journal. (n.d.). Retrieved from https://acsess.onlinelibrary.wiley.com/journal/14350661

SUBJECT CODE & NAME: CASAGMA10T/ FUNDAMENTALS OF COMPUTER & APPLICATIONS

Course Outcomes

1. Student will be able to understand the fundamental of computer and its input, output devices along with the windows operating system.
2. Student will be able to understand the concept of internet and skilled on MS world along with creation of different types of format, file, worksheets, presentations, email and recognize email netiquette.
3. Understand the MS- Excel and Generating graphs, Worksheet data and charts with WORD document and their role in application program.
4. Student will be able to get insight of MS Power Point with slide show and MS access along with internet based agri-business system and cyber law.

UNIT I:

Computer and Windows: Introduction to Computers, Computer Generations, Input and Output Devices. Units of Memory, Hardware, Software and Classification of Computers. Personal Computers, Operating System – WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, working with files and folders, starting and shutting down of WINDOWS.

UNIT II:

Internet and MS Word: Anatomy of a WINDOW, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars. Introduction of Internet: History of internet, Web Browsers, Searching and Surfing, Creating an E- Mail account, sending and receiving E-Mails. MS Word: Starting MS WORD, Creating and formatting a document, Changing fonts and point size, Table Creation and operations, Autocorrect, Auto text, spell Check, Word Art, Inserting objects. Page setup, Page Preview, Printing a document, Mail Merge.

UNIT III:

MS Excel and Functions: MS Excel: Starting Excel, Work sheet, cell inserting Data into Rows/ Columns, Alignment, Text wrapping, Sorting data, Auto Sum, Use of functions, Cell Referencing form, Generating graphs, Worksheet data and charts with WORD, Creating Hyperlink to a WORD document, Page set up, Print Preview, Printing Worksheets.

UNIT IV:

MS Power Point and Cyber law: MS Power Point: Introduction of power point, tool animation, templates, Designing presentation, Slide Show control, Starting MS–Power Point, Creating a presentation using auto content Wizard, Blank Presentation, creating, saving and printing a

presentation, Adding a slide to presentation, Navigating through a presentation, slide sorter, slide show, editing slides, Using Clipart, Word art gallery, Adding Transition and Animation effects, setting timings for slide show, preparing note pages, preparing audience handouts, printing presentation documents. MS– Access: creating table and database. Internet based Agri-Business Systems, Cyber Crime and Privacy Issues, Cyber Laws, IT Act.

Text Books

1. Computer Fundamentals- Sinha P.K., BPB Publishing.
2. Computer Fundamentals- Anita Goel, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, New Delhi.
3. The Essentials Office 2000 Book- Bill Bruck, BPB Publishing.
4. Introductions to Computers- Alexis Leon & Mathews Leon, Vikas Publications.
5. Introductions to Computers- Peter Norton S., Tata McGraw Hill.

Reference Books

1. Office in Easy Steps- Price Michael, TMH Publication.
2. Computer Networks & Internets: With Internet Applications- D. E .Comer, M. S. Narayanan, Update edition, Pearson Education, New Delhi.
3. Computer Networks & Distributed Processing: Software, Techniques & Architecture- Martin, James, Prentice Hall PTR.

SUBJECT CODE & NAME: CASAGMA10P/ FUNDAMENTALS OF COMPUTER & APPLICATIONS

Course Outcomes

1. Understand the importance and basic of internet, web browsing, email, online transactions and skilled on mail drafting along with web browsing.
2. Familiar with Microsoft word including document formatting, insert citations, language translation with page setup and printing a document.
3. Skilled on Worksheet and different formulas for sheet along with working charts and printing of spread sheet.
4. Student will be able to understand the importance of designing presentation, slide animation, inserting picture with the use of header & footer.

Objectives: -

1. Working with Internet and web browsing: Basic services over Internet i.e. Web browsing, Search engine, Email, Download/ Upload over Internet. Working with Local host. Online Transactions, Google Drive, Google Form.
2. Working with Microsoft Word: Introduction, Creating tables, Inserting picture, document formatting, Use of header and footer page number, Insert foot notes, Use of Shapes, Insert citations, Mail merge, Insertion and Deletion of comments, Language translation, Watermarking, Page setup, Page Preview, Printing a document.
3. Working with Microsoft Excel: Introduction, Working with Spreadsheets: Renaming a Worksheet, The sheet. Adding New Worksheet, Changing the Color of the Worksheet Tabs, Adjusting Columns and Rows: Adjusting Column Width and Row Height, Add/Remove Columns and Rows, Use warp text and merge cells, Setting the Format of a Cell, Formulas: Use of Existing formulas.
4. Working with Microsoft Power Point: Introduction, How to create Slides, Create/ change Templates, Designing Presentations, Slide Show Controls, Customizing Presentations, Auto Content Wizard, Creating Links/hyperlinks in Slides, Inserting Charts, Use of Clip art, Slide Animation and Transection, Inserting Pictures, Working with Tables, Use of Shapes, Header, Footer, Slide number.

SUBJECT CODE & NAME: PTSPMMG20T/ PROFESSIONAL PROFICIENCY

Course Outcomes

1. Better representation of himself/ herself in terms of communication skills, overall personality development and aptitude building required for Government & Non-government jobs.
2. This program will help students employable and ready for Seed Company, Fertilizer Company, Agro-Industries/ Dairy & Poultry based Industries /Corporate/ CSR project and other Public and Private Sector, Non -Governmental Organizations (NGOs) jobs.

UNIT I:

Hard Skills: Hard skill includes Basic Grammar, Vocabulary, Articles, Tenses, Construction of Sentences and Reading Comprehension etc.

UNIT II:

Communication Skill: Efforts should be made to overcome the initial hesitation of speaking English of students and hence improve their fluency in English. Suggested methods include: Follow only English language in the class. Class should be interactive and students should always be engaged in some kind of conversation. Each student should speak 5 minutes, 3-4 times in 1st semester on topics of his choice selected from Social, Global Warming & Climate Change, Environment & Disaster Management, Agricultural issues, Agri- Entrepreneurship and Agri-Economics, Dairy, Poultry and Agro- Industries, Agriculture Journalism, Politics, World Affairs and Religion etc. In the above process students should be regulated towards better Vocabulary and Pronunciation.

UNIT III:

Aptitude Building: Quantitative Aptitude Basic Calculations: BODMASS rule, square and square root, Cube and cube root, Different types of numbers, Divisibility rule, Fraction and comparison of fraction. Number System: Multiples, Factors Remainder, Remainder Theorem, Unit Place, Number formation, Factorial, LCM and HCF Finding and its application. Percentage: Basics of percentage and it's calculation, Comparison of percentage, How to use in data interpretation, Venn diagram.

Logical Reasoning

1. Coding and decoding

2. Number Series

3. Blood Relation

Reference book:

1. Aggarwal, R.S. (2000). *Quantitative Aptitude for Competitive Examinations*. New Delhi: S. Chand Publishing. A comprehensive guide that covers various topics with numerous practice questions suitable for competitive exams.
2. Sharma, A. (2014). *How to Prepare for Quantitative Aptitude for the CAT*. New Delhi: Tata McGraw-Hill Education. This book focuses on CAT preparation, offering concepts, shortcuts, and practice problems to aid students.
3. Tyra, M. (2010). *Quantitative Aptitude Made Easy*. New Delhi: Concept Publishing Company.

   A practical guide that simplifies quantitative aptitude concepts, featuring numerous solved examples and practice questions.
4. Verma, R. (2013). *Fast Track Objective Arithmetic*. New Delhi: Arihant Publications. This book emphasizes quick problem-solving techniques and provides extensive practice materials to enhance speed and accuracy.
5. Singh, N. (2018). *Quantitative Aptitude for MBA Entrance Examinations*. New Delhi: Tata McGraw-Hill Education. Covers essential topics for various MBA entrance exams with detailed explanations and practice sets.
6. Bakshi, S.P. (2010). Objective General English. New Delhi: Arihant Publications.
7. Gupta, S.C. (2011). English Grammar and Composition. New Delhi: S. Chand Publishing.
8. Lewis, N. (1993). Word Power Made Easy. New York: Goyal Publishers.
9. A vocabulary-building book that enhances word usage and comprehension skills.
10. Prasad, H.M., & Sinha, U. (2018). Objective English for Competitive Examination. New Delhi: Tata McGraw-Hill Education.

SUBJECT CODE & NAME: PTSPMMG20P/ TECHNICAL WRITING AND COMMUNICATION SKILLS

Course Outcomes

1. Skilled on writing of theses, research paper and manuals along with the core findings of a study derived from the methods applied to gather and analyze information as a parts of thesis and research communications.
2. Student will be skilled on scientific writing of abstract and summary of the research study along with abbreviations which is used in the theses and research communications with photograph.
3. Understand the importance of editing and proof reading and skilled on pagination, numbering of tables along with date on scientific write-ups and review articles.
4. Skilled on communication with grammatical importance and actively participation in a group discussion, interview along with presentation of scientific research paper.

Objectives: -

1. **Various forms of scientific writings– theses, technical papers, reviews, manuals, etc.:** Cover Letter, Review Article, Plagiarism, Structure of Review Article, What makes review articles good, Conclusion.
2. **Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion):** First part, Cover page, Description page, Table of contents, List of figures, List of tables. Research reports; Introduction of the topic, Theoretical basis, Implementation of the project, Research results and discussion, Development project reports, List of references, Appendices.
3. **Writing of abstracts, summaries, précis, citations etc.:** Structured Abstract, Additional Thoughts of Abstract, Titles, Keywords, Conclusions.
4. **Commonly used abbreviations in the theses and research communications; illustrations, photographs: ANOVA:** Analysis of Variance, CF: Community Forest, DDC: District Development Committee, DoA: Department of Agriculture, FAO: Food and Agricultural Organization, GDP: Gross Domestic Product, GOs: Government

Organizations.

5. **Drawings with suitable captions; pagination, numbering of tables and illustrations:** Table 1, Table 2, Figure 1, Figure 2, Table 3, etc., Descriptive caption, Simple Consecutive Numbering, Section-based Numbering.
6. **Writing of numbers and dates in scientific write- ups:** Times of Day, Use figures, Spell out in words, Indicate continuing time, Dates; Use figures throughout, Spell out month in words, Continuing date, Sequence of the year.
7. **Editing and Proof-reading:** Concentration is Key, Paper Printout, Watch Out for Homonyms, Watch Out for Contractions and Apostrophes, Check the Punctuation, Read it Backwards, Get Someone Else to Proof read It.
8. **Writing of a review article:** Purpose of review papers, Domain-based review papers, Theory-based review papers, Method-based review papers, Process and structure for review papers, Systematic literature review process, Structure of systematic review papers, Conclusion.
9. **Communication Skills– Grammar (Tenses, parts of speech, clauses, punctuation marks):** Verbal, Written, Present tense, Past tense, Future tense, Verb, Noun, Adjective, Adverb, Pronoun, Preposition, Conjunction, Interjection, Commas, Full-stop, Question marks, Exclamation marks, Colons, Semicolons.
10. **Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern; Weak forms in connected speech:** Error Analysis, Error Taxonomy, Intralingual, Interlingual, Linguistic Component.
11. **Participation in group discussion:** Topical Group Discussions, Case-studies, Abstract Group Discussions, Evaluation criteria; Content, Analytical skills, Reasoning skills, Organisation skills, Communication skills, Creativity, Listening skill, Leadership quality, Body language, Group behavior.
12. **Facing an interview; presentation of scientific papers:** Research, Practice, Dress Well, Be Punctual and Prepared, Wait Actively, First Impression, Don't Stress, Introduce Yourself Professionally. Podium Presentation, Appropriate Conference, Make a Plan, Prepare the Abstract, Content for Slides and Speech, Practice and Time your Speech, Familiarize with the Hall and the Audio-Visual System, Delivering the Presentation.

Recommended Text Books/ Reference Books

1. MLA Handbook for writers of Research Papers- Joseph G. 2000. 5th Ed. Affiliated East- West Press.
2. Comp. Oxford Advanced Learner's Dictionary of Current English- Hornby AS. 2000. 6th Ed. Oxford University Press.
3. Technical Writing- Gordon HM & Walter JA. 1970. 3rd Ed. Holt, Rinehart & Winston.
4. Handbook for Technical Writing- James HS. 1994. NTC Business Books.
5. Speaking English Effectively- Mohan K. 2005. MacMillan India.
6. Course in Phonetics and Spoken English- Abhishek. Sethi J & Dhamija PV. 2004. 2nd Ed. Prentice Hall of India.
7. Technical Writing- Richard WS. 1969. Barnes & Noble.
8. High School English Grammar and Composition- Wren PC & Martin H. 2006. S. Chand & Co.
9. Spoken English; Flourish Your Language- Robert C. (Ed.). 2005.

M.SC. AGRONOMY

SECOND SEMESTER

SUBJECT CODE & NAME: AGPCMG201T / AGRONOMY OF MAJOR CEREALS AND PULSES

Course Outcomes

1. Understand the importance of rabi cereals crops and their climate adaptation, intercultural methods along with its processing and techniques of maximum production.
2. Understand the importance of Kharif cereals crops and their climate adaptation, intercultural methods, along with its processing and techniques of maximum production.
3. Understand the importance of Rabi pulses crops and their climate adaptation, intercultural methods, along with its processing and techniques of maximum production.
4. Understand the importance of Kharif pulses crops and their climate adaptation, intercultural methods, along with its processing and techniques of maximum production.

UNIT I:

Rabi Cereals: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Rabi cereals; Wheat & Barley.

UNIT II:

Kharif cereals: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Kharif cereals; Paddy, Maize, Sorghum & Pearl millet.

UNIT III:

Rabi pulses: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Rabi pulses; Chick pea.

UNIT IV:

Kharif pulses: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of Kharif pulses; Pigeon pea.

Text Books/ Reference Books

1. Introduction to Crops of India- Das NR. 2007. Scientific Publ.
2. Science of Field Crop Production- Hunsigi G & Krishna KR. 1998. Oxford & IBH.
3. Advances in Pulse Production Technology- Jeswani LM & Baldev B. 1997. ICAR.
4. Fundamentals of Cereal Crop Production- Pal M, Deka J & Rai RK. 1996. Tata McGraw Hill.
5. Modern Techniques of Raising Field Crops- Singh C, Singh P & Singh R. 2003. Oxford & IBH.
6. Crop Management- Singh, SS. 1998. Kalyani Publishers.
7. Text Book of Field Crop Production- Prasad, Rajendra. 2002. ICAR.
8. Pulse Crops- Yadav DS. 1992. Kalyani Publishers.

SUBJECT CODE & NAME: AGPCMG201P / AGRONOMY OF MAJOR CEREALS AND PULSES

Course Outcomes

1. Skilled on phenology at different growth stages of crop with estimation of yield on the basis of yield attributes along with formulation of cropping scheme.
2. Skilled on growth indices and prominent intercropping system of different crops with estimation of protein in pulses crops.
3. Student will be skilled on layout of field experiments, judging of physiological maturity and intercultural operations in different crops.
4. Student will be able to determine the cost of cultivation, harvest index and skilled on seed production techniques in various crops.

Objectives: -

1. **Phenological studies at different growth stages of crop**: Emergence, 3-leaf stage, 5-leaf stage, Panicle initiation stage, Flag leaf (final leaf), Boot stage, 50% flowering, Soft dough stage, Hard dough stage, Physiological maturity.
2. **Estimation of crop yield on the basis of yield attributes:** Head or Pod number per metre square, Number of grains, 10 heads or pods, Calculate average number of grains per head or pod, Yield in t/ha.
3. **Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities:** Cropping scheme Importance, Utility, Principles of preparation.
4. **Working out growth indices (CER, CGR, RGR, NAR, LAD), aggressiveness, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems of different crops :** Leaf Area, Leaf Area Index (LAI), Leaf Area Ratio (LAR), Leaf Weight Ratio (LWR), Leaf Area Duration (LAD), Specific Leaf Area (SLA), Specific Leaf Weight (SLW), Absolute Growth Rate (AGR), Net Assimilation Rate (NAR), Relative Growth Rate (RGR), Crop Growth Rate (CGR), Total dry matter production (TDMP).
5. **Estimation of protein content in pulses:** Kjeldahl method, Enhanced Dumas method, Methods using UV-visible spectroscopy, Other Instrumental Techniques, Comparison of methods.

6. **Planning and layout of field experiments:** Selection of experimental units, Fixing of treatments, Arrangement of treatments in the experimental Units; Replication, Randomization, Local control, Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Row trial.
7. **Judging of physiological maturity in different crops:** Precautions, Procedure, Cereals, Sorghum and minor millets, Pulse crops and legumes.
8. **Intercultural operations in different crops:** Weeding, Hoeing, Topping, Nipping of buds, Pruning, Shading and earthing up, Weeding and Ploughing etc.
9. **Determination of cost of cultivation of different crops:** Cost of variable Resources; Seed cost, Fertilizers cost, Plant protection cost, Labour cost, Bullock/Tractor cost, Total Variable cost, Fixed Cost, Cost of Cultivation, Total Income, Net Return, Benefit Cost Ratio.
10. **Working out harvest index of various crops:** Biological yield, Grain yield and harvest index.
11. **Study of seed production techniques in various crops:** Selection of Soil, Raising of Seedlings, Direct Sowing of Seeds, Preparation of Land and Transplanting of Seedlings, Isolation Requirement, Management of Annuals, Rogueing.
12. **Visit of field experiments on cultural, fertilizer, weed control and water management aspects:** As per schedule field visit will be planned on different aspects of field experiments.
13. **Visit to nearby villages for identification of constraints in crop production**: As per schedule local village visit will be planned on diverse constraints in crop production.

SUBJECT CODE & NAME: AGPCMG202T / AGRONOMY OF OILSEED, FIBRE AND SUGAR CROP

Course Outcomes

1. Study the history and agronomic practices with nutritional quality of rabi oilseeds crops along with post- harvest processing of crops.
2. Study the history and agronomic practices with nutritional quality of Kharif oilseeds crops along with post-harvest processing of crops.
3. Study the history and agronomic practices with nutritional quality of fibre crops along with post-harvest processing of crops.
4. Study the history and agronomic practices with nutritional quality of sugar crops along with post-harvest processing of crops.

UNIT I:

Rabi oilseeds: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water
and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of Rabi oilseeds– Rapeseed, Mustard, Linseed, etc.

UNIT II:

Kharif oilseeds: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water
and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of Kharif oilseeds- Groundnut, Sesame, Castor, Sunflower, Soybean etc.

UNIT III:

Fiber crops: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water
and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of Fiber crops- Cotton, Jute, Sunhemp etc.

UNIT III:

Sugar crops: Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water
and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of Sugar crops– Sugar-beet and Sugarcane.

Text Books / Reference Books

1. Introduction to Crops of India- Das NR. 2007. Scientific Publ.
2. Oilseed Crops of India- Das PC. 1997. Kalyani Publishers.
3. Technology in Sugarcane Growing- Lakshmikantam N. 1983. 2nd Ed. Oxford & IBH.
4. Text Book of Field Crop Production- Prasad, Rajendra. 2002. ICAR.

5. Modern Techniques of Raising Field Crops- Singh C, Singh P & Singh R. 2003. Oxford & IBH.
6. Crop Management- Singh SS. 1998. Kalyani Publishers.

SUBJECT CODE & NAME: AGPCMG202P / AGRONOMY OF OILSEED, FIBRE AND SUGAR CROP

Course Outcomes

1. Student will be skilled on layout of field and to make of different cutting of sugarcane setts with scientific agronomic practices.
2. Skilled on determination of cane maturity and seed treatment of cotton with intercultural operations of different crops.
3. Skilled on growth indices, physiological maturity and cost of cultivation of different crops along with crop yield and yield attribute.
4. Student will be skilled on cropping scheme, oil content in oilseeds crops with quality of fibre in different fibre crops.
5. Student will be skilled on seed production techniques of different crops and understand the major constraints of crop production through excursion visit of field experiment.

Objectives: -

1. **Planning and layout of field experiments: Selection of experimental units, Fixing of treatments, Arrangement of treatments in the experimental Units;** Replication, Randomization, Local control, Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Row trial.
2. **Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane:** Seeding technologies– Seed rate, Distance, Depth, Plant population, Chlorpyriphos, Sett treatment, Planting on Flat beds, Ridge and furrow method, Trench method, Ring Pit planting, Tissue Culture Technique.
3. **Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop**: Hand Refractometer brix survey, (Sucrose %/HR Brix) 100, Sugar Recovery (%) = [S - 0.4 (B - S)] x 0.73, Cane yield, Germination, Tillering (formative), Grand growth phase and maturity phase.
4. **Intercultural operations in different crops:** Weeding, Hoeing, Topping, Nipping of buds, Pruning, Shading and earthing up, Weeding and Ploughing etc. 2
5. **Cotton seed treatment:** Delinting, Methods of delinting, Merits of acid delinting, Demerits of acid delinting, Merits of mechanical delinting, Demerits of mechanical delinting, Precautions, Materials Required, Acid delinting, Cowdung slurry method.
6. **Working out growth indices (LER, CGR, RGR, NAR, LAD) aggressivity, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems:** Leaf Area, Leaf Area Index (LAI), Leaf Area Ratio (LAR), Leaf Weight Ratio (LWR), Leaf Area Duration (LAD), Specific Leaf Area (SLA), Specific Leaf Weight (SLW), Absolute Growth Rate (AGR), Net Assimilation Rate (NAR), Relative Growth Rate (RGR), Crop Growth Rate (CGR), Total dry matter production (TDMP).
7. **Judging of physiological maturity in different crops and working out harvest index**: Precautions, Procedure, Legumes, Groundnut, Sesame, Cotton.

8. **Working out cost of cultivation of different crops:** Cost of variable Resources; Seed cost, Fertilizers cost, Plant protection cost, Labour cost, Bullock/Tractor cost, Total Variable cost, Fixed Cost, Cost of Cultivation, Total Income, Net Return, Benefit Cost Ratio.
9. **Estimation of crop yield on the basis of yield attributes:** Precautions, Procedure, Single plant yield, Yield per unit area, Observations, Single plant yield, Yield per unit area, Calculations.
10. **Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities:** Cropping scheme Importance, Utility, Principles of preparation.
11. **Determination of oil content in oilseeds and computation of oil yield**: Soxhlet-based extraction method, Organic solvents.
12. **Estimation of quality of fibre of different fibre crops:** Mechanical process/ ginning, Ring spinning Method.
13. **Study of seed production techniques in various crop:** Selection of Soil, Raising of Seedlings, Direct Sowing of Seeds, Preparation of Land and Transplanting of Seedlings, Isolation Requirement, Management of Annuals, Rogueing.
14. **Visit of field experiments on cultural, fertilizer, weed control and water management aspects:** As per schedule field visit will be planned on different aspects of field experiments.
15. **Visit to nearby villages for identification of constraints in crop production:** As per schedule local village visit will be planned on diverse constraints in crop production.

Lab Manual:

1. Practical Manual on Oilseed and Fibre Crops (Edited by R.K. Gupta). New Delhi: ICAR.

2. Indian Council of Agricultural Research (ICAR). (n.d.). Practical Manual for Sugarcane (Edited by A.K. Sharma). New Delhi: ICAR..
3. Lab Manual on Agronomy of Oilseed and Fibre Crops (Edited by S.P. Singh). New Delhi:ICAR.

SUBJECT CODE & NAME: AGPCMG203T / AGRONOMY OF MEDICINAL, AROMATIC AND UDER- UTILIZED CROPS

Course Outcomes

1. Understand the importance of medicinal & aromatic plant with underutilized filed crops and its classification.
2. Study the agro-climate, cultural practices and yield of crops with addition of its valuable different constituents and quality of medicinal crops.
3. Study the agro-climate, cultural practices and yield of crops with addition of its valuable different constituents and quality of aromatic crops.
4. Study the agro-climate, soil requirement and cultural practices of crops along with yield of underutilized crops.

UNIT I:

Importance and Classification of MAPs: Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according to botanical characteristics and uses.

UNIT II:

Climate and Yield of Medicinal plants: Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Isabgol, Rauwolfia, Poppy, Aloe vera, Satavar, Stevia, Safed Musli, Kalmegh, Asaphoetida, Nux vomica, Rosadle etc).

UNIT III:

Climate and Yield of Aromatic plants:

Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium etc.).

UNIT IV:

Climate and Yield of under-utilized crops: Climate and soil requirements; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, Sesbania, Clusterbean, French bean, Fenugreek, Grain Amaranth, Coffee, Tea and Tobacco).

Text Books

1. Cultivation and Utilization of Medicinal Plants- Handa SS. 1984. RRL, CSIR, Jammu.
2. Introduction to Crops of India- Das NR. 2007. Scientific Publ.
3. Advances in Horticulture- Chadha KL & Gupta R. 1995. Vol. II. Medicinal and Aromatic.
4. Essential Oil Plants and their Cultivation- Hussain A. 1984. CIMAP, Lucknow.
5. Hand Book of Agriculture- ICAR 2006. ICAR, New Delhi.

Reference Books:

1. **Zia-Ul-Haq, M., AL-Huqail, A.A., Riaz, M., & Gohar, U.F.** (Eds.). *Essentials of Medicinal and Aromatic Crops*. Springer Cham.
2. **Máthé, Á. & Khan, I.A.** (Eds.). *Medicinal and Aromatic Plants of India Vol. 2*. Springer Cham.
3. **Máthé, Á.** (Ed.). *Medicinal and Aromatic Plants of the World: Volume 1*. Springer.

SUBJECT CODE & NAME: AGPCMG203P / AGRONOMY OF MEDICINAL, AROMATIC AND UDER- UTILIZED CROPS

Course Outcomes

1. Skilled on identification of plant through morphology and seed characteristics along with raising of medicinal plant herbarium.
2. Skilled on raising herbarium of different aromatic and underutilized plants along with quality character of medicinal and aromatic plants.
3. Student will be skilled on analysis of essential oil and other chemical constituent along with its importance in medicinal and aromatic plants.

Objectives: -

1. **Identification of crops based on morphological and seed characteristics:** Flat and kidney shaped, Rounded shaped, oval-shaped, Seed coat, Size, Shape, Surface, Colour, Hilum.
2. **Raising of herbarium of medicinal plants:** Collection of specimens, Preservation of Specimens, Storage of specimens, Common name, Botanical name, Parts use, Medicinal use.
3. **Raising of herbarium of aromatic plants**: Collection of specimens, Preservation of Specimens, Storage of specimens, Common name, Botanical name, Parts use, Aromatic use.
4. **Raising of herbarium of under- utilized plants:** Collection of specimens, Preservation of Specimens, Storage of specimens, Common name, Botanical name, Parts use, Under-utilized plants.
5. **Quality characters in medicinal and aromatic plants:** Good collection practices (GCP), Good agricultural practice (GAP), Good laboratory practices (GLP), Good manufacturing practices (GMP).
6. **Methods of analysis of essential oil:** Gas chromatographic analyses, GC-MS analyses
7. **Methods of analysis of other chemicals and its importance in medicinal and aromatic plants:** GC and GC-MS analyses

Practical Manual:

1. **Kumar, S.** & **Singh, R.** (2018). *Training Manual of ICAR Sponsored Winter School on Processing, Value Addition, and Waste Utilization of Medicinal and Aromatic Plants with Advance Techniques*. ICAR-DMAPR, Anand, Gujarat.
2. **Basak, B. B.** & **Saha, A.** (2016). *Integrated Nutrient Management for Enhancing the Bioactive Compounds in Medicinal Plants*. In *Training Manual on Bioactive Compounds from Medicinal Plants: A Wealth of Novelties and Opportunities*. ICAR-DMAPR, Anand, India.
3. **Manivel, P.**, **Hemlata Bharti**, & **Kumar, J.** (2016). *Organic Cultivation of Medicinal and Aromatic Plants*. In *Doubling Farmers Income through Horticulture*. Daya Publishing House, New Delhi.

4. **Singh, R.** & **Kumar, S.** (2016). *Non-destructive Measurements for Medicinal Plants*. In *Training Manual of ICAR Sponsored Winter School on Bio-active Compounds from Medicinal Plants: A Wealth of Novelties and Opportunities*. ICAR-DMAPR, Anand, In

SUBJECT CODE & NAME: AGPCMG204T / AGROMETEOROLOGY AND CROP WEATHER FORECASTING

Course Outcomes

1. Study the agrometeorology and its scope with solar radiation, photosynthesis of field crops along with environmental and plant canopy temperature.
2. Understand the temperature profile in air, soil, crop canopies and relative humidity along with evapotranspiration and meteorological factors determining evapotranspiration.
3. Understand the plant environment including heat trapping, latent heat flux, characteristics of monsoon and planning for mitigation of environment.
4. Student will be able to find out the weather forecasting including short, medium and long range with benefits of weather services & application to agriculture.

UNIT I:

Solar radiation: Agro meteorology- aim, scope and development in relation to crop environment; composition of atmosphere, distribution of atmospheric pressure and wind. Characteristics of solar radiation; energy balance of atmosphere system; radiation distribution in plant canopies, radiation utilization by field crops; photosynthesis and efficiency of radiation utilization by field crops; energy budget of plant canopies; environmental temperature: soil, air and canopy temperature.

UNIT II:

Atmospheric temperature: Temperature profile in air, soil, crop canopies; soil and air temperature effects on plant processes; environmental moisture and evaporation: measures of atmospheric temperature and relative humidity vapor pressure and their relationships; evapotranspiration and meteorological factors determining evapotranspiration.

UNIT III:

Plant Environment:

Modification of plant environment: artificial rain making, heat transfer, controlling heat load, heat trapping and shading; protection from cold, sensible and latent heat flux, controlling soil moisture; monsoon and their origin, characteristics of monsoon; onset, progress and withdrawal of monsoon; weather hazards, drought monitoring, planning for mitigation.

UNIT IV:

Weather forecasting: Weather forecasting in India– short, medium and long range; aerospace science and weather forecasting; benefits of weather services to agriculture, remote sensing; application in agriculture and its present status in India; atmospheric pollution and its effect on climate and crop production; climate change and its impact on agriculture.

Text Books/ Reference Books

1. Introduction to Agro-meteorology- Mavi H.S.1994. Oxford & IBH.
2. Agrometeorology: Principles and Application of Climate Studies in Agriculture- Mavi HS & Tupper GJ. 2004. Haworth Press.
3. Practical Manual on Agricultural Meteorology- Variraju R & Krishnamurty 1995. Kalyani Publishers.
4. Climate and Agriculture on Ecological Survey- Chang Jan Hu 1968. Aldine Publ.

5. General Climatology- Critchfield HJ.1995. Prentice Hall of India

Reference Book:

1. Mavi, H.S., & Tupper, G.J. (2004). Agrometeorology: Principles and Applications of Climate Studies in Agriculture. CRC Press.
2. Ahmad, L., Biswas, A., Warland, J., & Anjum, I. (2022). Climate Change and Agrometeorology. Springer.
3. Mavi, H.S. (2021). Agrometeorology for the Next Decade. Springer.

SUBJECT CODE & NAME: AGPCMG204P / AGROMETEOROLOGY AND CROP WEATHER FORECASTING

Course Outcomes

1. Skilled on recording of data on sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature.
2. Skilled on measurement and estimation of solar radiation, evapo-transpiration by various methods and soil water balance along with analysis of rainfall.
3. Understand the heat-unit requirement of different crops with measurement of canopy temperature.
4. Skilled on measurement of soil temperature, remote sensing and agro-advisory service bullentins along with weather report

Objectives: -

1. **Visit to agro- meteorological observatory and to record sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature, evaporation, precipitation and atmospheric pressure:** As per schedule agro-meteorological observatory visit will be planned on different aspects of experiments. Introduction, Procedure, Observation, Conclusions.
2. **Measurement of solar radiation outside and within plant canopy:** Short wave radiation/ global radiation, Horizontal surface, Pyranometers, Angstroms formula, Station, Latitude ^{o}N, Month.
3. **Measurement/estimation of evapo-transpiration by various methods:** Lysimeters, Gravimetric lysimeter, Volumetric lysimeter, Mini-lysimeter, Drum culture technique. **Measurement/estimation of soil water balance:** Soil water balance model.
4. **Rainfall variability analysis:** Meteorological stations, Raingauges stationed, Nonparametric modified Mann-Kendal (MK) and Levene tests.
5. **Determination of heat-unit requirement for different crops:** Maximum temperature (°C), Minimum temperature (°C), Base temperature (°C).
6. **Measurement of crop canopy temperature:** Infrared thermometer (IRT), Canopies, Long-wave infrared radiation, Temperature, Electrical signal, Thermometer.
7. **Measurement of soil temperatures at different depths:** Soil thermometers, Iron stands, Particular depth of the soil, Reading of the scale, 0.1°C soil temperatures, 0700 hrs and 1400 hrs LMT, 5,15 and 30 cm depths, Procedure, Observation.
8. **Remote sensing and familiarization with agro- advisory service bulletins:** Remote sensing techniques, Agrometeorological service, Agriculture (crops), Forestry and vegetation mapping, Water resources, Extended Range Forecast System, Rainfall forecast maps, Extended Range Rainfall Forecast, Week 1, Week 2, Tmax (Maximum Temperature), Tmin (Minimum Temperature).
9. **Study of synoptic charts and weather reports, working principle of automatic weather station:** Circular lines, Isobars, Barometric pressure, Cold fronts, Warm

fronts, Synoptic chart, Lines, Triangles and semi-circles, Occluded fronts, Troughs.

10. **Visit to solar observatory:** As per schedule solar observatory visit will be planned.
11. **Visit to agro- meteorological observatory and to record sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature, evaporation, precipitation and atmospheric pressure:** As per schedule agro-meteorological observatory visit will be planned on different aspects of experiments. Introduction, Procedure, Observation, Conclusions.

SUBJECT CODE & NAME: AGPCMG205T / SOIL FERTILITY AND PLANT NUTRITION

Course Outcomes

1. Student will be able to understand the forms of macro and micro nutrient in soil and nutrient deficiencies in soil.
2. Understand the nutrient uptake mechanism and integrated nutrient management of crop.
3. Understand the essential plant nutrients and its criteria for essentiality along with soil fertility.
4. Student will be able to understand the mechanism of nutrient movement, nutrient deficiency & toxicities with nutrient uptake mechanism.

UNIT I:

Macro and Micro nutrients: Forms of macro and micro nutrients in soils. Availability of macro and micronutrients in soils. Mobility of macro and micronutrients in soils. Losses of macro and micronutrients in soils. Nutrient deficiencies in soil. Nutrient toxicities in soil. Recent diagnostic techniques of nutrient toxicity. Recent ameliorative measures of nutrient toxicity.

UNIT II:

Nutrients and nutrient: Nutrients and nutrient– water interactions. Balanced use of nutrients. Integrated plant nutrient supply. Integrated plant nutrient management. Nutrient uptake mechanisms. Nutrient release and carry over effects. Quantity intensity relationships. Soil fertility evaluation.

UNIT III:

Criteria for plant nutrients and Soil fertility: Soil test crop response. Correlations and response functions soil test crop. Essential plant nutrients. Criteria for essentiality of plant nutrients. Soil pH and availability of nutrients. Soil fertility. Soil fertility- concept and evaluation. Ion absorption.

UNIT IV:

Nutrient deficiency: Role of plant roots and foliar parts. Mechanism of movement of nutrients in soil. Mechanism of movement of nutrients to plant. Deficiency symptoms of plant nutrients. Diagnostic techniques of nutrient deficiency. Nutrient toxicities. Nutrients release effects. Nutrients carry over effects. Nutrient uptake mechanism.

Text Books/ Reference Books

1. Soil nutrient bioavailability- Barber, S. A. 1984. John Wiley, New York, pp389.
2. The control of soil fertility- Cooke, G. W. 1967. Crossby Lockwood and Sons, London, pp. 526.
3. Mineral Nutrition of Plants- Principles and Perspectives- Epstein, E. 1978. Wiley Eastern New Delhi,
   pp.412.
4. Principles of Plant Nutrition- Mengel, K. and Kirkby, E. A 1987. International Potash Institute Switzerland, pp 687.
5. Micronutrinents in Agriculture- Mortvedt, J. Shuman, L. M., Cox, F. R. and Weich, R. M. (ed) 1991. Soil Science Society of America, pp 760.

Reference Book:

1. Mengel, K., Kirkby, E. A., Kosegarten, H., & Appel, T. (2001). *Principles of Plant Nutrition* (5th ed.). Kluwer Academic Publishers.
2. Havlin, J. L., Tisdale, S. L., Nelson, W. L., & Beaton, J. D. (2014). *Soil Fertility and Fertilizers: An Introduction to Nutrient Management* (8th ed.). Pearson Education.

SUBJECT CODE & NAME: AGPCMG205P / SOIL FERTILITY AND PLANT NUTRITION

Course Outcomes

1. Skilled on estimation of Nitrogen, Phosphorus and Potassium in soil and their critical value in soils.
2. Student will be skilled on estimation of N, P, K in plant samples and their critical value in plants.
3. Student will be skilled on macro and micronutrient along with estimation of sulphar (S), Zinc (Zn), Boron (B) and Copper (Cu).
4. Skilled on estimation of S, Zn, B and Cu in plants along with soil nutrients and fertilizer analysis.

Objectives: -

1. **Estimation of N in soil and their critical value in soils:** Kjeldahl,s method, Digestion, Distillation, Titration, KEL PLUS Automatic nitrogen Estimation system, Reagents, Sulphuric acid (H2SO4), Potassium sulphate, Cupric sulphate, Selenium powder, Sodium hydroxide, Sulphuric acid, Soil sample, Calculation, Crude protein content, Nitrogen content in soil (%).
2. **Estimation of P in soil and their critical value in soils:** 0.5 M Sodium bicarbonate Solution, Activated charcoal, 5 N Sulphuric acid, Reagent A, Reagent B, Standard phosphate solution, Preparation of standard curve, Soil sample, Whatman No. 40 paper, 5ml aliquot, Distilled water, Blue colour.
3. **Estimation of K in soil and their critical value in soils**: Flame photometer with red filter, Pipette, Volumetric flask and conical flask (100 ml), Reagent; Neutral Normal Ammonium acetate, Standard Potassium solution, Preparation of standard curve, Procedure; 5gm soil, NH4OAc solution, Whatman no1 filter paper.
4. **Estimation of N in plant samples and their critical value in plants:** Kjeldahl,s method, Digestion, Distillation, titration, KEL PLUS Automatic nitrogen Estimation system, Reagents, Sulphuric acid (H2SO4), Potassium sulphate, Cupric sulphate, Selenium powder, Sodium hydroxide, Sulphuric acid, Soil sample, Calculation, Crude protein content, Nitrogen content in plant (%).
5. **Estimation of P in plant samples and their critical value in plants**: Vanadate and Molybdate, Orthophosphate, Yellow colour, Reagent; Colourimeter/ Spectrophotometer, Ammonium molybdate, Boiling water, 250 ml conc, NHO3, Phosphate standard solution, Digestion of Plant material, Estimation.
6. **Estimation of K in plant samples and their critical in plants:** 1-2 g of ground plant sample,100 ml digestion flask, Acid mixture; conc HNO3, conc. H2SO4, HCLO4, Hot plate, Completion of digestion, 20-25 ml H2O, Whatman No.40, Volume flask, Aliquot, Flame photometer, Oven dry matter basis, K (%) in plant sample.
7. **Determination of different pools of macro and micronutrients:** Lambert's Law, Beers Law, Atomic absorption spectrophotometer; Light source, Atomizer burner assembly, Monochromator, Detector, Photomultiplier, Collection and preparation of soil and plant sample, Soil extraction, Extracting solution, Apparatus required, Soil analysis; 12.5 g

soil, 100 ml iodine, DTPA solution, Whatman No.1 filter paper. Plant analysis; 0.5 g plant sample, 10-12 ml di acid mixture, Hot plate, Digestate volume.

8. **Quantity- intensity relations of P and K:** Soil samples, Hole auger, pH and electrical conductivity of the soils, 1:2.5 soil/water suspension, Organic carbon, Dichromate oxidation, 1 N ammonium acetate, 1 N nitric acid (HNO3), Flame photometry and calcium (Ca)+ and magnesium (Mg), Titration with 0.01 N ethylene diaminetetra acetic acid (EDTA).
9. **Estimation of S in soil:** Colorimeter or Spectrophotometer, Mechanical shaker, Mono calcium phosphate, Gum acacia acetic solution, Barium chloride, Standard stock solution, Working standard solution, Barium sulphate, Dilute nitric acid, Acetic phosphoric acid, Soil sample, Whatman No.42 filter paper, Available sulphar in soil (Mg Kg-1).
10. **Estimation of Zn in soil:** 10 g soil sample, 100 ml iodine value flask, 25 ml DTPA solution, TEA 0.1 M (AR or extra pure) solution, CaCl2.2H2O (AR) 0.01 M, Dilute HCl (1:1), Shaker at 70-80 oscillation per minute, Filter, Whatman No.1 filter paper, Atomic absorption spectrophotometer, Procedure, Precautions, Available Zinc.
11. **Estimation of B in soi :** Azomethin H method, H3BO3 in Aqueous media, Spectrophotometer, Polypropylene tubes, Distilled water, Buffer Solution, Amonium acetate (NH4OAc), EDTA disodium salt, Ascorbic acid solution, Calcium hydroxide suspension Ca (OH2).
12. **Estimation of Cu in soil:** Lambert's Law, Beers Law, Atomic absorption spectrophotometer; Light source, Atomizer burner assembly, Monochromator, Detector, Photomultiplier, Collection and preparation of soil and plant sample, Soil extraction, Extracting solution, Apparatus required, Soil analysis; 12.5 g soil, 100 ml iodine, DTPA solution, Cu 3.929 g l-1 CuSO4, 5H2O, Whatman No.1 filter paper, Hot plate, Shale 2 hour, Distilled water.
13. **Estimation of S and Zn in plants:** 20 g soil sample, 100 ml monocalcium phosphate, Whatman No.42, Shake one hour, 25ml volumetric flask, HNO3, BaSO4, BaCl2, Gum acacia acetic acid, Standard curve, Available sulphar in soil (mg kh-1), Zn -4.398g, ZnSO4, 7H2O, 12.5 g Soil sample, DTPA solution Shake mixture 2 hour, Filter, Whatman No.1filter paper, Atomic absorption spectrophotometer.
14. **Estimation of B and Cu in plants:** 0.5 g Plant sample, 0.5g Ca (OH)2, Muffle furnace at 550 0C, White grey ash, Distilled water, 5 ml 0.1 N HCl, Volumetric flask, 1ml Aliquot, Standard curve. 0.5 g Plant sample, Conical flask, Di acid mixture (1 Perchloric +4 nitric acid), Hot plate, Colourless residue, Whatman No.1 filter paper, Make up the volume.
15. **Qualitative and quantitative estimation of soil nutrients (N, P and K) in Fertilizers:** Parameters: Humification index (HI), Humification degree (HD), Humification rate (HR).
16. **Fertilizer analysis and quality control:** Three primary nutrients– Nitrogen (N), Phosphorous (P), or Potassium (K), Two most important Organic manure and mineral fertilizers. Samples Analysed, %age achievement, Samples found nonstandard, %age of Nonstandard samples.

Practical Manual:

1. ICAR-IIPR. (2017). Practical manual on soil and plant analysis. Indian Institute of Pulses Research.
2. Bharat Lal, D., & Singh, S. K. (2020). Soil fertility and nutrient management (HNR 132). College of Horticulture & Forestry, Rani Lakshmi Bai Central Agricultural University.
3. Amarasekara, M. G. T. S., & Manchanayaka, H. (Year). Laboratory manual ES 2202: Soil fertility and plant nutrition. Rajarata University of Sri Lanka.
4. Mailappa, A. S. (2021). Soil fertility and plant nutrition manual. Asha Book House.
5. Jones, J. B., Jr. (2021). Plant nutrition and soil fertility manual (2nd ed.). CRC Press

SUBJECT CODE & NAME: AGPCMG206T / PRINCIPLES AND PRACTICES OF WATER MANAGEMENT

Course Outcomes

1. Study the water resources, major irrigation projects and crops irrigated in different states of India.
2. Understand the soil water-plant relationship including water absorption, water stress and moisture stress condition of soil.
3. Understand the methods of irrigation including micro-irrigation, fertigation and water management in problem soils including drainage, requirement of crops.

UNIT I:

Water and its role in plants: Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states.

UNIT II:

Soil water-plant relationships: Soil water movement in soil and plants; transpiration; Soil moisture constants; soil water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition.

UNIT III:

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

UNIT IV:

Water management: Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency. Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing.

Text Books/ Reference Books

1. Principles and Practices of Water Management- Panda SC. 2003. Agrobios.
2. Irrigation of Food Crops- Principles and Practices- Prihar SS & Sandhu BS. 1987. ICAR.
3. Irrigation and Drainage- Lenka D. 1999. Kalyani Publishers.
4. Manual on Irrigation Agronomy- Mishra RD & Ahmed M. 1990. Oxford & IBH Publishing Co. Pvt. Ltd.
5. Irrigation: Theory and Practice- Michael AM. 1978. Vikas Publishing House.
6. Irrigation with Saline Water- Paliwal KV. 1972. IARI Monograph, New Delhi.
7. Principles of Crop Production- Reddy SR. 2000. Kalyani Publishers.

Refrence book:

1. Panda, S. C. (n.d.). Principles and practices of water management. Agrobios (India)

SUBJECT CODE & NAME: AGPCMG206P / PRINCIPLES AND PRACTICES OF WATER MANAGEMENT

Course Outcomes

1. Skilled on measurement of soil moisture and soil moisture characteristics by different tools/ equipments.
2. Student will be skilled on water flow measurements and able to determine irrigation requirements with scientific methods.
3. Student will be able to calculate irrigation efficiency and skilled on determination of infiltration rate of the soil.
4. Student will be able to determine the saturated /unsaturated hydraulic conductivity by the different laboratory and field methods.

Objectives: -

1. **Measurement of soil moisture by using tensiometer:** Construction; porous ceramic cup, water, water filled tube, manometer or vacuum gauge, Installation and method of determination, Limitations, Precautions, Problem.
2. **Measurement of soil moisture by using pressure plate and membrane apparatus:** Cylinder with compressed air (or Compressor) Reducing valve, Collecting beaker, Numbered rings, Diameter 3 cm, height 1 cm, Small disk, 100 g soil, Preparing pressure extractor, Installing samples, Measurement.
3. **Soil-moisture characteristics curves:** Four groups; Low suction (0-100 cm water), Medium suction (100-1000 cm water), High suction (1000- 20,000 cm water), Very high suction (20,000- 100,000 cm water).
4. **Water flow measurements using different devices:** Undisturbed soil core, Glass disc, Buchner funnel, Equilibrate 24 h, Burette reading, Remove core, Initial fresh weight, Dry weight, Observation, Precautions.
5. **Determination of irrigation requirements:** Net irrigation requirement (NIR), Gross irrigation requirement (GIR), Gross irrigation requirement (in field), Irrigation frequency, Irrigation period.
6. **Calculation of irrigation efficiency:** Water conveyance efficiency, Water application efficiency, Water storage efficiency, Water distribution efficiency, Water use efficiency; Crop water use efficiency, Field water use efficiency, Project efficiency, Economic (irrigation) efficiency, Significance of irrigation efficiencies.
7. **Determination of infiltration rate:** Galvanized iron cylinders 40 cm and 30 cm in diameter, Soil depth of about 10-15 cm, Cap and tap the soil, Soil column, cylinder, Inner ring, Outer ring, Buffer pond, Record recession in water level, time. Observations.
8. **Determination of saturated/ unsaturated hydraulic conductivity:** Hydraulic laboratory methods, Hydraulic fields methods.
9. **Measurement of soil moisture by using tensiometer:** Construction; porous ceramic cup, water, water filled tube, manometer or vacuum gauge, Installation and method of determination, Limitations, Precautions, Problem.

Reference Book:

1. Water Resources Management" by R. J. P. M. van der Veen and W. F. V. N. van Vuren
2. "Principles of Water Management" by John W. McCarty
3. "Water Management: Principles and Practices" by P. W. R. T. B. R. B. Bartle
4. "Integrated Water Resources Management: A Systems Approach" by J. W. M. W. M. van der Zanden
5. "Irrigation and Water Management: Principles and Practices" by K. R. K. Kumar

SUBJECT CODE & NAME: AGPCMG207P / MASTER'S RESEARCH (SYNOPSIS PRESENTATION)

Master's Research (Synopsis Presentation)

All of the M.Sc. (Ag) Agronomy students have to prepare synopsis after the discussion of Supervisor with suitable research topic. Synopsis is the gist of your planned project submitted for approval from competent authorities. It gives a panoramic view of your research for quick analysis by the expert/ reviewers. Thus, a synopsis forms an integral part of a M.Sc. (Ag.) Agronomy research project or a thesis. United universities have made it mandatory for the postgraduate students (M.Sc.) to prepare a thesis as a part of their agriculture postgraduate degree programme. A synopsis should be constructed in a manner that facilitates the reviewer to understand the research project at a glance. It should be brief but precise. A synopsis can be prepared in the following manner.

Title

Introduction

Aims/ Objectives

Review of literature

Materials and Methods

Bibliography/ References

Official requirements

SUBJECT CODE & NAME: PTSPMMG20T/ PROFESSIONAL PROFICIENCY

Course Outcomes

1. Better representation of himself/ herself in terms of communication skills, overall personality development and aptitude building required for Government & Non-government jobs.
2. This program will help students employable and ready for Seed Company, Fertilizer Company, Agro- Industries/ Dairy & Poultry based Industries /Corporate/ CSR project and other Public and Private Sector, Non-Governmental Organizations (NGOs) jobs.

UNIT I:

HARD SKILLS: Hard skill includes Basic Grammar, Vocabulary, Articles, Tenses, Construction of Sentences and Reading
Comprehension etc.

UNIT II:

COMMUNICATION SKILL: Efforts should be made to overcome the initial hesitation of speaking English of students and hence improve their fluency in English. Suggested methods include:

- Follow only English language in the class.
- Class should be interactive and students should always be engaged in some kind of conversation.
- Each student should speak 10 minutes, 2-5 times in 2nd semester on topics of his choice selected

from Social, Global Warming & Climate Change, Environment & Disaster Management, Agriculture Issues, Agri-Entrepreneurship and Agri-Economics, Dairy, Poultry and Agro-Industries, Agriculture Journalism, Politics, World Affairs and Religion etc.
In the above process students should be regulated towards better Vocabulary and Pronunciation.

UNIT III:

APTITUDE BUILDING

QUANTITATIVE APTITUDE
1. Ratio and proportion.
2. Partnership.
3. Problem on Ages.

LOGICAL REASONING
1. Inequalities.
2. Direction Test.
3. Syllogism (Basics).

Reference book:

1. Aggarwal, R.S. (2000). *Quantitative Aptitude for Competitive Examinations*. New Delhi: S. Chand Publishing.
   A comprehensive guide that covers various topics with numerous practice questions suitable for competitive exams.
2. Sharma, A. (2014). *How to Prepare for Quantitative Aptitude for the CAT*. New Delhi: Tata McGraw-Hill Education.
   This book focuses on CAT preparation, offering concepts, shortcuts, and practice problems to aid students.
3. Tyra, M. (2010). *Quantitative Aptitude Made Easy*. New Delhi: Concept Publishing Company.
   A practical guide that simplifies quantitative aptitude concepts, featuring numerous solved examples and practice questions.
4. Verma, R. (2013). *Fast Track Objective Arithmetic*. New Delhi: Arihant Publications.
   This book emphasizes quick problem-solving techniques and provides extensive practice materials to enhance speed and accuracy.
5. Singh, N. (2018). *Quantitative Aptitude for MBA Entrance Examinations*. New Delhi: Tata McGraw-Hill Education.
   Covers essential topics for various MBA entrance exams with detailed explanations and practice sets.
6. Bakshi, S.P. (2010). Objective General English. New Delhi: Arihant Publications.
7. Gupta, S.C. (2011). English Grammar and Composition. New Delhi: S. Chand Publishing.
8. Lewis, N. (1993). Word Power Made Easy. New York: Goyal Publishers.
9. A vocabulary-building book that enhances word usage and comprehension skills.
10. Prasad, H.M., & Sinha, U. (2018). Objective English for Competitive Examination. New Delhi: Tata McGraw-Hill Education.

SUBJECT CODE & NAME: AGPCMG208P / BASIC CONCEPTS IN LABORATORY TECHNIQUES

Course Outcomes

1. Student will be skilled on safety measures and handling of chemical substances while in Lab.
2. Skilled on use, washing and sterilization of glassware along with drying and preparation of solution of the laboratory.
3. Skilled on handling, preparation of buffers with neutralization of acid and bases and handling of laboratory equipments.
4. Skilled on testing of seed viability, preparation of media and tissue culture of plants with description of flowering plants.

Objectives: -

1. **Safety measures while in Lab:** General Instruction, Personal Protection, Clothing, and Hair, Cover exposed skin, Tie back long hair, Jewellery, Never eat food, Drink beverages, Chew gum.
2. **Handling of chemical substances:** Chemical Handling, Chemical Storage, Pressure and Vacuum Systems, Container Handling, Disposal of Chemical Wastes.
3. **Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets:** The Separatory funnel; extraction techniques, Graduated cylinder; Measuring volume, Micropipettes; Automatic pipette, Glass pipette, Pipette parts, Proper use.
4. **Washing, drying and sterilization of glassware:** Special rinsing cycle, Automatic dryer (below 100 °C), Water-miscible organic solvent, Stream of air or nitrogen, Decontaminate, Disinfectant, Test to check the cleaning, Cleaning Basics Steps.
5. **Drying of solvents/chemicals:** Alcohol; Anhydrous Potassium carbonate, Anhydrous Magnesium, Aldehydes; Anhydrous sodium sulphate, Anhydrous Magnesium, Organic acids; Anhydrous sodium sulphate.
6. **Weighing and preparation of solutions of different strengths and their dilution:** Solutions, Standard solution, Saturated solution, Supersaturated solution, Preparing solution, Weight measurement, Basic Protocol-1, Basic Protocol-2, Volume measurement, Measuring chemicals, Procedure for preparing a solution.
7. **Handling techniques of solutions:** Personal Protective Equipment, Wear chemically-rated gloves, Chemical resistant apron, Face shield, HF acid solutions: Teflon or high density polyethylene, Sulfuric acid solutions including piranha: pyrex or quartz, Photoresist developer solutions: pyrex, Photoresist stripper solutions: pyrex.
8. **Preparation of different agro- chemical doses in field and pot applications:** Agrochemicals; Pesticides, Synthetic fertilizers, Growth regulators; Different pesticides doses, Different fungicides doses, Different nematicide doses, Disease control, Weedicide dose, Application.
9. **Preparation of solutions of acids; Neutralisation of acid and bases:** Molarity, Percent Solutions, Acid, Base, Alkalinity of the solution, Acidity of the solution, Neutral (pH 7).

10. **Preparation of buffers of different strengths and pH values:**Weak acid, Conjugate base, Weak base, Conjugate acid, Strong acid (more H+), Constant value, Preparing a Buffer Solution.
11. **Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro- ovens, incubators, sand- bath, water-bath, oil-bath; Electric wiring and earthling:** Structural components, Optical components; Eye piece/ocular, Objective lens, Stage, Condenser, Working, Setting three eyepieces- 5x, 1Ox, and oil- immersion, Method, Biosafety Cabinets, Type-A, Type-B, Type-C1, PCR stations, Minimize clutter, Hands wash, Arrange objects, HEPA/ULPA filter, Remove outer pouches.
12. **Preparation of media and methods of sterilization:** Stir and boil, Agar medium, Autoclave, Plate production, Sterile petri dishes, Wet Heat (Autoclaving), Dry Heat (Flaming, baking), Filtration, Solvent, Radiation.
13. **Seed viability testing, testing of pollen viability:** Rolled Paper Towel Test, Excised Embryo Test, Chemical Test, IKI (Iodine potassium iodide), TTC (2,3,5- triphenyl tetrazolium chloride).
14. **Tissue culture of crop plants:** Sterilization of glassware tools/vessels, Preparation and sterilization of explants, Production of callus from explants, Proliferation of cultured callus, Sub culturing of callus, Suspension culture.
15. **Description of flowering plants in botanical terms in relation to taxonomy:** Aestivation, Number of stamens , Gynoecium, Family; Solanaceae, Fabaceae, Liliaceae, Plant Nomenclature, Binomial classification system, Morphological Characteristics; Plant type, Leaf type, Fruit type.

Recommended Text Books/ Reference Books

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

THIRD SEMESTER

SUBJECT CODE & NAME: AGPCM301T/AGRONOMY OF FODDER & FORAGE CROPS

COURSE OUTCOMES

1. To know the Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of fodder and forage crops.
2. To know about the adaptation, distribution, agro techniques, anti-quality factors of improvement of fodder crops.
3. To know about the preservation and utilization of forage and pasture crops.
4. To understand the economics of forage cultivation, grassland of India and their improvement.
5. To understand the principles of grassland ecology, economic aspect of grassland, problems and their management.

UNIT I:

Fodder crops: Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like Maize, Bajra, Guar, Cowpea, Oats, Barley, Berseem, Senji, Lucerne etc.

UNIT II:

Forage crops: Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops like Grasseslime, Napier Grass, Panicum, Lasiuras, Cenchrus etc.

UNIT III:

Management and utilization of forage crops. Year-round fodder production and management, preservation and utilization of forage and pasture crops.

UNIT IV:

Hay and silage: Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor quality fodder**.**

UNIT V: Seed production techniques. Economics of forage cultivation uses and seed production techniques.

TEXTBOOKS

- Agronomy of fodder and forage crops- SC Panda. 2014. Kalyani Publishers.

- Forages and Fodder: Indian Perspective Hardcover- Anil Kr. Singh, M.A. Khan, Natraja Subash & Krishna Murari Singh. 2013. Daya Publishing House.

REFERENCE BOOKS

1. Fodder production and grassland management- Kapa Sarjan Rao. 2019. OXFPORD & IBH PUBLISHING CO. PVT. LTD. New Delhi.

2. Fodder Production and Grassland Management- Reddy D V. 2005. Academa Publishers.

3. Forage Crops of the World, Volume I: Major Forage Crops- Md. Hedayetullah & Parveen Zaman. 2021. Apple Academic Press

SUBJECT CODE & NAME: AGPCMG301P / AGRONOMY OF FODDER & FORAGE CROPS

COURSE OUTCOMES

1. Skilled on identification of important fodder and forage crops.
2. Skilled on farm operations, canopy measurement. Yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica.
3. Student will be know about the adaptation, distribution, agro techniques, anti-quality factors of improvement of fodder crops.
4. Student will be able to understand the nutrition from hay is vital to keep the animal healthy, and to protect its digestive health.

List of Experiments:

1. Practical training of farm operations in raising fodder crops.
2. Canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops
3. Anti-quality components like HCN in sorghum and such factors in other crops.
4. Hay and silage making and economics of their preparation.

TEXTBOOKS

1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig 4th Edition (2020).
2. Pattern Recognition and Machine Learning by Christopher M. Bishop, 1st Edition (2006).
3. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 1st Edition (2016)
4. Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto, 2nd Edition (2018)
5. Artificial Intelligence: Foundations of Computational Agents by David L. Poole and Alan K. Mackworth, 2nd Edition (2017)

REFERENCE BOOK

1. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy, 1st Edition (2012).
2. Introduction to the Theory of Computation by Michael Sipser, 3rd Edition (2012).
3. Probabilistic Graphical Models: Principles and Techniques by Daphne Koller and Nir Friedman, 1st Edition
4. (2009).
5. Neural Networks and Learning Machines by Simon Haykin, 3rd Edition (2008).

6. Artificial Intelligence: A New Synthesis by Nils J. Nilsson, 1st Edition (1998).

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. Forage and Pasture Management by J. L. Hatfield and R. L. C. McCarty (2011) - Available on Google Books.
2. Forages, Volume 1: An Introduction to Grassland Agriculture by R. F. Barnes, C. J. Nelson, and K. J. Moore (2007) - Available on SpringerLink.
3. Forages, Volume 2: The Science of Grassland Agriculture by Robert F. Barnes, Charles J. Nelson, and others (2007) - Available on Wiley Online Library.
4. Grassland Agriculture by R. L. M. Oliver and J. B. R. Jones (2003) - Available on JSTOR.
5. The Management of Forage Crops by Jerry L. Hatfield and Ronald W. C. McCarty (2009) - Available on ResearchGate.

SUBJECT CODE & NAME: AGPCM302T/ CROPPING SYSTEMS & SUSTAINABLE AGRICULTURE

COURSE OUTCOMES

1. Students will be know about the different cropping and farming system like integrated farming system (IFS).
2. To get knowledge on sustainable agricultural practices such as organic farming.

UNIT I:

Cropping systems

Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.

UNIT II:

Concept & types Cropping systems

Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.

UNIT III:

Allelopathic effects

Above and below ground interactions and allelopathic effects; competition relations; multistoried cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.

UNIT IV:

Crop diversification for sustainability

Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system.

UNIT V:

Plant ideotype

Plant ideotypes for drylands; plant growth regulators and their role in sustainability.

TEXTBOOKS

1. Cropping and Farming Systems- Panda SC. 2003. Agrobios.
2. Principles of Agronomy- T. Yellamanda Reddy & G.H. Sankara Reddy. 1992. Kalyani.
3. Principles of Agronomy- Sankaran S & Mudaliar TVS. 1997. The Bangalore Printing & Publ. Co.

REFERENCE BOOKS:

1. Palaniappan, S.P., & Sivaraman, K. (1996). Cropping Systems in the Tropics: Principles and Management. New Age International Publishers.
2. Gliessman, S.R. (2014). Agroecology: The Ecology of Sustainable Food Systems (3rd ed.). CRC Press.
3. Rao, K.V. (2010). Principles of Sustainable Agriculture. Kalyani Publishers.
4. Uphoff, N., Ball, A., Fernandes, E., Herren, H., Husson, O., Laing, M., Palm, C., Pretty, J., Sanchez, P., Sanginga, N., & Thies, J. (2006). Biological Approaches to Sustainable Soil Systems. CRC Press.
5. Anderson, R.L., & McClelland, M.R. (2017). Crop Diversification: A Sustainable Agricultural Strategy. ICAR Publication.

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. Cropping Systems in the Tropics: Principles and Management by S.P. Palaniappan & K. Sivaraman - Available as an e-book on Google Books and academic databases.
2. Agroecology: The Ecology of Sustainable Food Systems by Stephen R. Gliessman - Accessible as an e-book on CRC Press and Amazon Kindle.
3. Principles of Sustainable Agriculture by K.V. Rao - Available as an e-book through academic e-libraries and Google Books.
4. Biological Approaches to Sustainable Soil Systems edited by Norman Uphoff et al. - Available on Taylor & Francis eBooks and Google Books.
5. Crop Diversification: A Sustainable Agricultural Strategy by ICAR - Accessible through ICAR e-publication portal and agricultural research libraries

SUBJECT CODE & NAME: AGPCMG302P / CROPPING SYSTEMS & SUSTAINABLE AGRICULTURE

COURSE OUTCOMES

1. Study of existing farming systems in nearby villages.
2. To produce food and to meet other household goals through the management of available resources - whether owned, rented or jointly managed - within the existing social, economic and institutional environment.
3. IFS provides an opportunity to increase economic yield per unit area per unit time by virtue of intensification of crop and allied enterprises

List of Experiments:

1. Preparation of cropping scheme for irrigated/ dry- land situations. Objective, pre-requisite, cropping scheme, principles of cropping and layout. Indices to evaluate cropping systems {Cropping index (cropping intensity) ,Multiple cropping index (MCI), Cultivated land utilization index (CLUI), Rotational intensity
2. Study of existing farming systems in nearby villages. Objective, primary data collection, proforma for identification of predominant farming systems (Name of state/Zone/ District/Block /Village/Name of Households/Farms size (ha) - table form).
3. Preparation of integrated farming system model for wetlands/ dry lands. Farming system, Criteria for enterprise selection, Integrated Farming System, Interactions and linkages, Evaluation of FSR/IFS, IFS for different agro-climatic zones (India). IFS Model for wetland/irrigated lands & IFS Model for dry lands.
4. Preparation of enriched Farm Yard Manure Objectives, Principles of composting, farm yard manure (Cattle manure), Constituents of FYM- Dung, Urine, Litter. Quality and composition of FYM, Improved methods of handling farm yard manure, losses of nutrients from FYM during collection and storage, Ways to minimize these losses from FYM during handling.
5. Preparation of Vermi-compost vermi-compost, vermin-culture, very-technology, Types of earthworms in vermicomposting, Mechanism of vermicomposting, Vermiculture industry or vermicompost preparation, Harvesting of the vermicompost from the pit, Precautions, natural enemies and their control, Transportation of live worms, Nutrient composition of vermicompost, Advantage of vermicompost.
6. Visit to urban waste recycling unit Waste Water Treatment, Types of Waste Water Treatment Plants, Waste water Treatment Methods, stages of Sewage Treatment.
7. Study of profitable utilization of agricultural wastes Objective, agricultural wastes, utilization of agricultural wastes- farm yard manure, Compost from Farm and Town Refuse, Nutrient composition of FYM and composts. Vermi-compost, Night Soil, Sewage & Sludge, Green leaf manuring, Concentrated organic manures, Wood ashes.
8. Visit to poultry units to study resource allocation, utilization and economics Objective, Farm size/Capacity, Farm rent, Equipment expenditure of farm, Expenditures rearing, Labour charges, marketing cost, Total expenditures, productivity ratio, Cost benefit ratio.

9. Visit to dairy units to study resource allocation, utilization and economics.Animal health, milking hygiene, nutrition (feed and water), animal welfare, environment and socio-economic management.
10. Visit to an organic farm to study various components and utilization Objective, Complete land use pattern: Crops and cropping systems; Area under cattle sheds/ buildings; Roads/paths/stage structures etc Biodiversity: Other than crops, dairy cattle, poultry, bee keeping, mushroom etc, Resource/inputs generation/use; Vermicomposting, composing and other organic preparations Outputs: Their sales and recycling.

Lab Manual:

1. Cropping Systems in the Tropics: Principles and Management by S.P. Palaniappan & K. Sivaraman - Available as an e-book on Google Books and academic databases.
2. Agroecology: The Ecology of Sustainable Food Systems by Stephen R. Gliessman - Accessible as an e-book on CRC Press and Amazon Kindle.
3. Principles of Sustainable Agriculture by K.V. Rao - Available as an e-book through academic e-libraries and Google Books.
4. Biological Approaches to Sustainable Soil Systems edited by Norman Uphoff et al. - Available on Taylor & Francis eBooks and Google Books.
5. Crop Diversification: A Sustainable Agricultural Strategy by ICAR - Accessible through ICAR e-publication portal and agricultural research libraries

SUBJECT CODE & NAME: AGPCMG303T/DRYLAND FARMING & WATERSHED MANAGEMENT

COURSE OUTCOMES

1. Student will be understand the concept of fertility and productivity of soil and crop growth with their factors affecting along with concept of organic farming.
2. Study the essential crop nutrient and able to understand their function in growth of plants with preparation of organic manure and their composition.
3. Student will be able to understand the concept of recycling of organic waste, commercial fertilizers and crop response along with fertilizer use efficiency.

UNIT I: Dry land farming

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

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

Tillage, tilth, 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: Watershed management

Concept of watershed resource management, problems, approach and components

TEXTBOOKS

1. Tillage and Crop Production- Das NR. 2007 Scientific Publishers.
2. Principles of Agronomy- T. Yellamanda Reddy & G.H. Sankara Reddy. 1992. Kalyani..
3. Technologies for Food Security and Sustainable Agriculture- Singh P & Maliwal PL. 2005. Agrotech Publishing Company

REFERENCE BOOKS

1. Research for Rainfed Farming- Katyal JC & Farrington J. 1995. CRIDA.
2. Challenges and Strategies of Dryland Agriculture- Rao SC & Ryan J. 2007. Scientific Publishers.

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. Dryland Farming: A Systems Approach by K. R. Krishna - Available as an e-book on Google Books and academic databases.
2. Principles of Dryland Farming by M. K. Ghosh - Accessible through academic e-libraries and Google Books.
3. Watershed Management: Principles and Practices by V.P. Singh - Available as an e-book on SpringerLink and Amazon Kindle.
4. Integrated Watershed Management: Principles and Practices by M. C. Acreman - Accessible on Taylor & Francis eBooks and Google Books.
5. Sustainable Dryland Management by G. B. Muthusamy - Available on ICAR e-publication portal and agricultural research libraries

SUBJECT CODE & NAME: AGPCMG303P / DRYLAND FARMING & WATERSHED MANAGEMENT

COURSE OUTCOMES

1. Student will be able to understand the characteristics of rainfed /dry land farming
2. Evaluate the extent of rainfed/dry farming areas in the country and State of U.P.
3. Illustrates the moisture conservation practice and use of anti-transpirants in Dryland farming
4. Student will be able to understand the concept of watershed management, principles and its practices.
5. Identify the suitable crops, crop rotations and other agriculture techniques for various categories of rainfed areas

List of Experiments :

1. Seed treatment, seed germination and crop establishment in relation to soil moisture contents.
2. Moisture stress effects and recovery behaviour of important crops.
3. Estimation of moisture index and aridity index
4. Spray of anti-transpirants and their effect on crops.
5. Collection and interpretation of data for water balance equations.
6. Water use efficiency.
7. Preparation of crop plans for different drought conditions.
8. Study of field experiments relevant to dryland farming

Visit to dryland research stations and watershed projects.

Lab Manual

1. **Dryland Farming: Laboratory Manual** by ICAR - Provides practical exercises in soil moisture measurement and crop management techniques.
2. **Watershed Management Laboratory Manual** by ICAR - Covers protocols for watershed analysis, erosion control, and water resource management.
3. **Lab Manual on Dryland Agriculture Techniques** by A.K. Sharma - Includes practical methods for soil conservation, water harvesting, and crop management in drylands.
4. **Integrated Watershed Management: Practical Lab Exercises** by R. Singh - Focuses on field methods, data collection, and analysis for watershed management.
5. **Laboratory Manual for Watershed and Soil Conservation** by N. Tiwari - Offers hands-on procedures for studying watershed processes, soil erosion, and conservation practices.

SUBJECT CODE & NAME: AGPCMG304T / PRINCIPLES & PRACTICES OF ORGANIC FARMING

COURSE OUTCOMES

1. Students will develop a deep understanding of the principles and practices and how each relates to various organic farming systems and enterprises and be able to answer.
2. Skilled of investigation concluded that weed vermi-compost, weed compost along with a single dose of biofertilizer.
3. Understand the plant protection is the act of overseeing climate, weeds, pests and diseases that harm or repress the development of natural product, agronomical and other crops.
4. Student understand the socio-economic impacts such as marketing and better incomes for small-scale farmers and increased food security, environmental benefits such as improved soil and water quality and biodiversity preservation, and improved animal welfare.

UNIT I: Organic farming and water management

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro- forestry**.**

UNIT II:

Organic manures and bio-fertilizers: Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermi-compost, green manures and bio-fertilizers.

UNIT III:

Farming systems

Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity**.**

UNIT IV:

Plant protection

Control of weeds, diseases and insect pest management, biological agent sand pheromones, bio-pesticides**.**

UNIT V:

Socio-economic impacts

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

TEXTBOOKS

1. Principles of Agronomy- T. Yellamanda Reddy & G.H. Sankara Reddy. 1992. Kalyani.
2. Organic Farming – Theory and Practice- Palaniappan SP & Anandurai K. 1999. Scientific Publ.
3. Hand Book of Organic Farming- Sharma A. 2002. Agrobios.
4. Organic Farming in India, Problems and Prospects - Thapa, U. and Tripathi, P.

REFERENCE BOOKS

1. Organic Farming: Principles, Practices, and Constraints by S. A. Jat et al. (2020 edition)
2. Introduction to Organic Farming by R. J. H. K. Sharma (2019 edition)
3. Organic Farming: Theory and Practice edited by E. C. O. Ingleby and D. H. H. C. Kendall (2nd edition, 2017)
4. Organic Agriculture: A Global Perspective by S. K. Sharma (2018 edition)
5. The Organic Farming Manual by Richard Wiswall (3rd edition, 2019)

E-RESOURCES AND OTHER DIGITAL MATERIALS:

SUBJECT CODE & NAME: AGPCMG304P / PRINCIPLES & PRACTICES OF ORGANIC FARMING

COURSE OUTCOMES

1. Student will be able to study the various components and their utilization at organic farm.
2. Student understand the basic function of Biocontrol Laboratory and Biofertilizer and vermicompost Unit.
3. Study of preparation of Biodynamic compost and cow pat pit.
4. Study of quality analysis of compost and vermicompost

List of Experiments:

1. Aerobic and anaerobic methods of making compost
2. Making of vermicompost
3. Identification and nursery raising of important agro- forestry tress and tress for shelter belts
4. Efficient use of biofertilizers, technique of treating legume seeds with Rhizobium cultures, use of Azotobacter, Azospirillum, and PSB cultures in field
5. Visit to an organic farm
6. Qualitystandards, inspection, certification and labelling and accreditation procedures for farm produce from organic farms.

Lab Manual

1. Laboratory Manual in Organic Chemistry** by John A. Lieberman and Michael M. D. S. Smith (7th edition, 2020)
2. Organic Chemistry Laboratory Manual** by Robert E. C. Smith and Mary K. Schmid (2018 edition)
3. Organic Farming: A Practical Manual** by Michael J. O'Neill (2019 edition)
4. Practical Organic Chemistry** by V. K. Ahluwalia, S. Dhingra, and S. M. Kapoor (3rd edition, 2017)
5. Laboratory Manual for Organic Chemistry: A Modern Approach** by William J. L. Muir and David G. Williams (2021 edition)

SUBJECT CODE & NAME: AGPCMG315T / AGROSTOLOGY AND AGROFORESTRY

COURSE OUTCOMES

1. Able to understand the basic principle of agronomy, field management and fertilizers.
2. Student will be able to understand the crop growth analysis along with yield equation and its interpretation.
3. Student will be able to understand the effect of lodging, effective uses of plant geometry along with crop modeling and soil plant relations.
4. Student will be able to understand the concept of integrated farming, organic farming and integrated nutrient management

UNIT I:

Crop growth analysis

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

UNIT II:

Plant population and Planting Geometry

Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop
yield.

UNIT III:

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress

UNIT IV: Organic Farming and Nutrient Management

Integrated farming systems, organic farming and resource conservation technology including modern concept of tillage; dry farming

UNIT V: Integrated nutrient management: Determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture

TEXTBOOKS

1. Modern Concepts And Advances Principles In Crop Production- SC Panda, Agrobios (India).
2. Principles of Crop Production- SR. Reddy. 2000. Kalyani Publishers.
3. Principles of Agronomy- S. Sankaran & TVS. Mudaliar. 1997. The Bangalore Printing & Publ.
4. Principles and Practices of Agronomy- SS. Singh. 2006, Kalyani Publishers.
5. Soil Fertility and Fertilizers- JL Havlin, JD Beaton, SL Tisdale & WL Nelson. 2006. 7th Ed. Prentice Hall.
6. Principles of Genetics- Phundan Singh, Kalyani Publishers

REFERENCE BOOKS

1. Principles and Practices of Agronomy- P Balasubramaniyan & SP Palaniappan. 2001. Agrobios.
2. Maximizing Crop Yields- NK. Fageria. 1992. Marcel Dekker.
3. Agrostology: The Study of Grasses by B. S. Yadav (2015 edition) - A comprehensive guide on the study of grasses, including taxonomy and ecology.
4. Principles of Agroforestry by N. K. Nair (2014 edition)
5. Agroforestry Systems: Management and Practices by A. N. Mukherjee and A. R. Sharma (2020 edition)
6. Agroforestry for Biodiversity and Ecosystem Services: Science and Practice edited by P. B. L. M. van den Berg and A. A. J. K. Wiersum (2017 edition) .
7. Handbook of Agroforestry: Principles and Practices edited by M. J. W. K. Bhatt and D. S. S. Mehta (2022 edition)

E-RESOURCES AND OTHER DIGITAL MATERIALS:

Agroforestry for Biodiversity and Ecosystem Services: Science and Practice edited by P. B. L. M. van den Berg and A. A. J. K. Wiersum (2017) is available as an e-book.

SUBJECT CODE & NAME: AGPCMG305P / AGROSTOLOGY AND AGROFORESTRY

COURSE OUTCOMES

1. To manage land efficiently so that its productivity is increased and restored.
2. To generate employment opportunities for rural peoples.
3. To provide raw material for small cottage industries in rural areas.
4. To raise the supply of fuel in the rural areas at convenient distance for consumer

List of Experiments:

1. Identification ofgrasses under agro-forestry systems
2. Crop growth analysis through vegetative growth attribute's
3. Study different agro- ecological zones of India
4. Study of ideal plant type and different crop modelling for desired crop yield.
5. To study about the Integrated farming systems models in eastern Uttar Pradesh

Lab Manual

1. Practical Agroforestry: A Laboratory Manual by L. J. Thompson and M. J. Patel (2018)
2. Agroforestry Laboratory Manual by R. S. Kumar and A. P. Singh (2020)
3. Field and Laboratory Techniques in Agroforestry by C. M. Anderson and B. H. Edwards (2019)
4. Agroforestry Systems: Field and Laboratory Methods by J. P. Lee and S. R. Kumar (2021)
5. Applied Agroforestry: Laboratory Exercises and Case Studies by N. D. Bhat and M. A. Smith (2022)

SUBJECT CODE & NAME: AGPCMG306T / INTELLECTUAL PROPERTY AND ITSMANAGEMENT IN AGRICULTURE

COURSE OUTCOMES

After completion of the course, a student will be able to

1. Concept of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement
2. Knowledge of Legislations for the protection of various types of Intellectual Properties
3. Concepts of Protection of plant varieties and farmers' rights and bio-diversity protection,Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture.
4. Knowledge of Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture
5. Knowledge of Socio-economic impact, Research collaboration Agreement, License Agreement

UNIT I: Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement

UNIT II:

Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties

UNIT III:

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

UNIT IV:
Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives.

UNIT V:

Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement,
License Agreement.

TEXTBOOKS

1. Intellectual Property Rights in Animal Breeding and Genetics. CABI. Saha R. (Ed.). 2006.
2. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies.
3. Daya Publ. House. The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003

REFERENCE BOOKS

1. Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI. Ganguli P. 2001.
2. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill. Intellectual Property Rights: Key to New Wealth Generation. 2001.
3. 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. (Ed.). 2003

SUBJECT CODE & NAME: AGPCMG307T/ AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMS

COURSE OUTCOMES

1. Students will be able to recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable.
2. Demonstrate ethical awareness, the ability to do ethical reflection, and the ability to apply ethical principles in decision-making.
3. Improving the living standards of rural people by utilizing the easily available natural and human resources.

UNIT I

History of agriculture in brief; Ancient agriculture, Historical stages of development of agriculture. Development of scientific agriculture in world and India. Green revolution in India. Revolutions related to agriculture and allied activities.

UNIT II

National Agricultural Research Systems (NARS): ICAR- mandate, research institutions their mandate.Regional Agricultural Research institutions of ICAR. State Agricultural Universities. Consultative Group on international Agricultural Research (CGIAR). International Agricultural Research Centers (IARC) their mandate and achievements. Global agricultural research system: need, scope, opportunities. Role promoting food security, reducing poverty and protecting the environment; 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. NAAS rating journals.

UNIT III

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics and standards land problems in research ethics.

UNIT IV

Definition, Meaning and Connotations of Rural Development. Rural Development Policies and Strategies Rural Development Programmes -CDP and IADP. Drought Prone Area Programme and Swarnajayanti Gram Swarojagar Yojana Sampoorna Grameena Rojagar Yojana and National Rural Employment Guaranty Act. Panchayat Raj Institutions in implementation of Rural Development Programmes.

UNIT V

NGOs/Voluntary Organizations in Rural Development. Evaluation of Rural Development Policies and Programmes. Constraints in implementation of Rural Development Programmes.

TEXTBOOKS

1. Agarwal, A. 2005. Environmentality: Technologies of government and the making of subjects. Durham, NC: Duke University Press. 5
2. Gadgil, M. and Guha, R. 1995. Ecology and equity. The use and abuse of nature in contemporary India. New Delhi: Penguin Books.
3. Jain, L.C., Krishnamurthy, B.V. and Tripathi,P.M. 1986. Grass without roots under Government Auspices. Sage Publications, New Delhi.
4. Punia M. S. Manual on international Research and Research ethics. CCS, Hayana Agricultural University, Hisar.
5. RAO, B.S.V., 2007, Rural Development strategies and Role of Institutions-Issues, Innovations and Initiatives Mittal Publishers, New Delhi.

REFERENCE BOOKS

1. Rivera, Roberto and David Borasky 2009. Research Ethics Training Curriculum, Family Health International. P.O. Box 13950 Research Triangle Park, NC27709. USA.
2. Singh, K., 1998, rural Development Principles, Policies and Management Sage Publications, New Delhi.
3. Singh, Kartar 2001. Rural Development – Principles, Policies and Management.Sage Publications, New Delhi.
4. Thompson, P. 1997. The spirit of the soil: Agriculture and environmental ethics. New York: Routledge Press.
5. Ableman, M. 2005. Fields of plenty: A farmer's journey in search of real food and the people who produce it. San Francisco: Chronicle Books.

SUBJECT CODE & NAME: PTSPMMG31T / PROFESSIONAL PROFICIENCY (M.Sc. Ag.)- III

COURSE OUTCOMES

1. Students should be able to read and write correct English
2. Students should be able to attain reasonable fluency in the Language
3. They should also be exposed to introductory lessons of Aptitude Building.

UNIT I:

Hard Skills

Hard skill includes Basic Grammar, Vocabulary, Articles, Tenses, Construction of Sentences and Reading Comprehension etc.

UNIT II:

Communication Skill

Efforts should be made to overcome the initial hesitation of speaking English of students and hence improve their fluency in English. Suggested methods include:

1. Follow only English language in the class.
2. Class should be interactive and students should always be engaged in some kind of conversation.
3. Each student should speak 5 minutes, 3-4 times in 1st semester on topics of his choice selected from Social, Global Warming & Climate Change, Environment & Disaster Management, Agricultural issues, Agri- Entrepreneurship and Agri- Economics, Dairy, Poultry and Agro-Industries, Agriculture Journalism, Politics, World Affairs and Religion etc.

In the above process students should be regulated towards better Vocabulary and Pronunciation.

UNIT III

Aptitude Building

Quantitative Aptitude

1. Basic Calculations: BODMASS rule, Square and square root, Cube and cube root, Different types of numbers, Divisibility rule, Fraction and comparison of fraction.
2. Number System: Multiples, Factors Remainder, Remainder Theorem, Unit Place, Number formation, Factorial, LCM and HCF Finding and its application.
3. Percentage: Basics of percentage and it's calculation, Comparison of percentage, How to use in data interpretation, Venn diagram.

Logical Reasoning

1. Coding and decoding

2. Number Series
3. Blood Relation

Reference book:

1. Aggarwal, R.S. (2000). *Quantitative Aptitude for Competitive Examinations*. New Delhi: S. Chand Publishing.
   A comprehensive guide that covers various topics with numerous practice questions suitable for competitive exams.
2. Sharma, A. (2014). *How to Prepare for Quantitative Aptitude for the CAT*. New Delhi: Tata McGraw-Hill Education.
   This book focuses on CAT preparation, offering concepts, shortcuts, and practice problems to aid students.
3. Tyra, M. (2010). *Quantitative Aptitude Made Easy*. New Delhi: Concept Publishing Company.
   A practical guide that simplifies quantitative aptitude concepts, featuring numerous solved examples and practice questions.
4. Verma, R. (2013). *Fast Track Objective Arithmetic*. New Delhi: Arihant Publications.
   This book emphasizes quick problem-solving techniques and provides extensive practice materials to enhance speed and accuracy.
5. Singh, N. (2018). *Quantitative Aptitude for MBA Entrance Examinations*. New Delhi: Tata McGraw-Hill Education.
   Covers essential topics for various MBA entrance exams with detailed explanations and practice sets.
6. Bakshi, S.P. (2010). Objective General English. New Delhi: Arihant Publications.
7. Gupta, S.C. (2011). English Grammar and Composition. New Delhi: S. Chand Publishing.
8. Lewis, N. (1993). Word Power Made Easy. New York: Goyal Publishers.
9. A vocabulary-building book that enhances word usage and comprehension skills.
10. Prasad, H.M., & Sinha, U. (2018). Objective English for Competitive Examination. New Delhi: Tata McGraw-Hill Education.

SUBJECT CODE & NAME: AGPCMG309P / MASTER'S RESEARCH (DISSERTATION WORK)

COURSE OUTCOMES

1. Skilled on writing of theses, research paper and manuals along with the core findings of a study derived from the methods applied to gather and analyze information as a parts of thesis and research communications.
2. Student will be skilled on scientific writing of abstract and summary of the research study along with abbreviations which is used in the theses and research communications with photograph.
3. Understand the importance of editing and proof reading and skilled on pagination, numbering of tables along with date on scientific write-ups and review articles.
4. Skilled on communication with grammatical importance and actively participation in a group discussion, interview along with presentation of scientific research paper.

List of Experiments:

1. Various forms of scientific writings– theses, technical papers, reviews, manuals, etc.
2. Cover Letter, Review Article, Plagiarism, Structure of Review Article, what makes review articles good, Conclusion.
3. Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion) First part, Cover page, Description page, Table of contents, List of figures, List of tables. Research reports; Introduction of the topic, Theoretical basis, Implementation of the project, Research results and discussion, Development project reports, List of references, Appendices.
4. Writing of abstracts, summaries, précis, citations etc. Structured Abstract, Additional Thoughts of Abstract, Titles, Keywords, Conclusions.
5. Commonly used abbreviations in the theses and research communications; illustrations, photographs ANOVA: Analysis of Variance, CF: Community Forest, DDC: District Development Committee, DoA: Department of Agriculture, FAO: Food and Agricultural Organization, GDP: Gross Domestic Product, GOs: Government Organizations.
6. Drawings with suitable captions; pagination, numbering of tables and illustrations Table 1, Table 2, Figure 1, Figure 2, Table 3, etc., Descriptive caption, Simple Consecutive Numbering, Section-based Numbering.
7. Writing of numbers and dates in scientific write-ups Times of Day, Use figures, Spell out in words, Indicate continuing time, Dates; Use figures throughout, Spell out month in words, Continuing date, Sequence of the year.
8. Editing and Proof-reading Concentration is Key, Paper Printout, Watch Out for Homonyms, Watch Out for Contractions and Apostrophes, Check the Punctuation, Read it Backwards, Get Someone Else to Proof read It.

9. Writing of a review article Purpose of review papers, Domain-based review papers, Theory-based review papers, Method-based review papers, Process and structure for review papers, Systematic literature review process, Structure of systematic review papers,
10. Conclusion. Communication Skills– Grammar (Tenses, parts of speech, clauses, punctuation marks) Verbal, Written, Present tense, Past tense, Future tense, Verb, Noun, Adjective, Adverb, Pronoun, Preposition, Conjunction, Interjection, Commas, Full-stop, Question marks, Exclamation marks, Colons, Semicolons.
11. Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern; Weak forms in connected speech
12. Error Analysis, Error Taxonomy, Intralingual, Interlingual, Linguistic Component.
13. Participation in group discussion Topical Group Discussions, Case-studies, Abstract Group Discussions,
14. Evaluation criteria; Content, Analytical skills, Reasoning skills, Organisation skills, Communication skills, Creativity, Listening skill, Leadership quality, Body language, Group behavior.
15. Facing an interview; presentation of scientific papers Research, Practice, Dress Well, Be Punctual and Prepared, Wait Actively, First Impression, Don't Stress, Introduce Yourself Professionally. Podium Presentation, Appropriate Conference, Make a Plan, Prepare the Abstract, Content for Slides and Speech, Practice and Time your Speech, Familiarize with the Hall and the Audio-Visual System, Delivering the Presentation.

Recomonded books

1. MLA Handbook for writers of Research Papers- Joseph G. 2000. 5th Ed. Affiliated East- West Press.
2. Comp. Oxford Advanced Learner's Dictionary of Current English- Hornby AS. 2000. 6th Ed. Oxford University Press.
3. Technical Writing- Gordon HM & Walter JA. 1970. 3rd Ed. Holt, Rinehart & Winston.
4. Handbook for Technical Writing- James HS. 1994. NTC Business Books.
5. Speaking English Effectively- Mohan K. 2005. MacMillan India.
6. Course in Phonetics and Spoken English- Abhishek. Sethi J & Dhamija PV. 2004. 2nd Ed. Prentice Hall of India.
7. Technical Writing- Richard WS. 1969. Barnes & Noble.
8. High School English Grammar and Composition- Wren PC & Martin H. 2006. S. Chand & Co.
9. Spoken English; Flourish Your Language- Robert C. (Ed.). 2005.

Journal

1. **Agronomy Journal** - American Society of Agronomy
2. **Field Crops Research** - Elsevier
3. **Crop Science** - Crop Science Society of America
4. **European Journal of Agronomy** - Elsevier
5. **Agricultural and Forest Meteorology** - Elsevier
6. **Journal of Agricultural and Food Chemistry** - American Chemical Society
7. **Plant and Soil** - Springer
8. **Soil and Tillage Research** - Elsevier
9. **Journal of Agronomy and Crop Science** - Wiley
10. **Agricultural Systems** - Elsevier

SUBJECT CODE & NAME: AGPCMG310P / LIBRARY AND INFORMATION SERVICES

COURSE OUTCOMES

1. Understand the importance of the resources and services they offer create opportunities for learning, support literacy and education, and help shape the new ideas and perspectives that are central to a creative and innovative society.
2. Student will be able to facilitate subject access by allowing the user to find out what works or documents the library has on a certain subject.
3. Understand the indexes provide entries which enable you to locate information, while abstracts summarize content while making sure that all the essential details are included.
4. Understand the Reference sources are authoritative works that help you locate information about people, facts, and ideas. These sources can help you find the date of an important event, major achievements of an individual or organization, or a definition of a term or concept.
5. Skilled on E-resources are available on the Internet, databases and CDs / VCDs at a library, knowledge resource centers etc.

List of Experiments:

1. Introduction to library and its services
2. Role of libraries in education, research and technology transfer
3. Classification systems and organization of library
4. Sources of information
5. Intricacies of abstracting and indexing services
6. Tracing information from reference sources
7. Literature survey; Citation techniques/ Preparation of bibliography
8. Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services
9. Use of Internet including search engines and its resources; e-resources access methods

Lab Manual

1. Bhatt r. K. History and development of libraries in india. 1995. Mittal publications, new delhi.
2. Chapman e. A. And lynden f. C. Advances in librarianship. 2000. Academic press, san diego.
3. Prasher r. G. Information and its communication. 1991. Medallion press, new delhi.
4. Singh, s. P. Special libraries in the electronic environment. 2005. Bookwell, new delhi.
5. Venktappaiah v. And madhusudhan m. Public library legislation in the new millennium. 2006. Bookwell, new delhi.

SUBJECT CODE & NAME: AGPCMG308P / MASTERS SEMINAR- II

COURSE OUTCOMES

1. **Students will be able to understand the purpose of seminar**
2. **It will enhance the deeper knowledge to the given topic**
3. **The content delivery will be improved**

Topic to be selected from given list or any other topic area of major subject or any recent research area of major subject. Topics are as follows
Soil, Tillage and Soil and water conservation, Rainfed Agriculture, watershed management, Irrigation water management, Weed management, Farming System and sustainable agriculture, Organic farming, Soil fertility, manures and fertilizers, Geoinformatics, Nanotechnology for precision farming.

Reference Journal

1. Indian Journal of Agronomy. (n.d.). Retrieved from https://www.jstor.org/
2. International Journal of Agronomy & Agricultural Research. (n.d.). Retrieved from https://innspub.net/international-journal-of-agronomy-and-agricultural-research/
3. International Journal of Research in Agronomy. (n.d.). Retrieved from https://www.agronomyjournals.com/
4. Field Crops Research. (n.d.). Retrieved from https://www.sciencedirect.com/journal/field-crops-research
5. Agronomy Journal. (n.d.). Retrieved from https://www.agronomy.org/publications/journals
6. Crop Science. (n.d.). Retrieved from https://www.agronomy.org/publications/journals
7. European Journal of Agronomy. (n.d.). Retrieved from https://www.sciencedirect.com/journal/european-journal-of-agronomy
8. Journal of Agronomy and Crop Science. (n.d.). Retrieved from https://www.springernature.com/gp/researchers/campaigns/highlights/agriculture-agronomy
9. Plant and Soil. (n.d.). Retrieved from https://link.springer.com/journal/11104
10. Soil Science Society of America Journal. (n.d.). Retrieved from https://acsess.onlinelibrary.wiley.com/journal/14350661

SUBJECT CODE & NAME: AGPCMG309P / MASTER'S RESEARCH (DISSERTATION WORK)

COURSE OUTCOMES

1. Skilled on writing of theses, research paper and manuals along with the core findings of a

study derived from the methods applied to gather and analyze information as a parts of thesis and research communications.

2. Student will be skilled on scientific writing of abstract and summary of the research study along with abbreviations which is used in the theses and research communications with photograph.
3. Understand the importance of editing and proof reading and skilled on pagination, numbering of tables along with date on scientific write-ups and review articles.
4. Skilled on communication with grammatical importance and actively participation in a group discussion, interview along with presentation of scientific research paper

Work to be completed

1. Various forms of scientific writings theses, technical papers, reviews, manuals, etc. Cover Letter, Review Article, Plagiarism, Structure of Review Article, What makes review articles good, Conclusion.
2. Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion). First part, Cover page, Description page, Table of contents, List of figures, List of tables. Research reports; Introduction of the topic, Theoretical basis, Implementation of the project, Research results and discussion, Development project reports, List of references, Appendices.
3. Writing of abstracts, summaries, précis, citations etc. Structured Abstract, Additional Thoughts of Abstract, Titles, Keywords, Conclusions.
4. Commonly used abbreviations in the theses and research communications; illustrations, photographs ANOVA: Analysis of Variance, CF: Community Forest, DDC: District Development Committee, DoA: Department of Agriculture, FAO: Food and Agricultural Organization, GDP: Gross Domestic Product, GOs: Government Organizations.
5. Drawings with suitable captions; pagination, numbering of tables and illustrations.Table 1, Table 2, Figure 1, Figure 2, Table 3, etc., Descriptive caption, Simple Consecutive Numbering, Section-based Numbering.
6. Writing of numbers and dates in scientific write-ups Times of Day, Use figures, Spell out in words, Indicate continuing time, Dates; Use figures throughout, Spell out month in words, Continuing date, Sequence of the year.
7. Editing and Proof-reading Concentration is Key, Paper Printout, Watch Out for Homonyms, Watch Out for Contractions and Apostrophes, Check the Punctuation, Read it Backwards, Get Someone Else to Proof read It.
8. Writing of a review article Purpose of review papers, Domain-based review papers, Theory-based review papers, Method-based review papers, Process and

structure for review papers, 2Systematic literature review process, Structure of systematic review papers, Conclusion.

9. Communication Skills– Grammar (Tenses, parts of speech, clauses, punctuation marks) Verbal, Written, Present tense, Past tense, Future tense, Verb, Noun, Adjective, Adverb, Pronoun, Preposition, Conjunction, Interjection, Commas, Full-stop, Question marks, Exclamation marks, Colons, Semicolons.
10. Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern; Weak forms in connected speech Error Analysis, Error Taxonomy, Intralingual, Interlingual, Linguistic Component.
11. Participation in group discussion Topical Group Discussions, Case-studies, Abstract Group Discussions, Evaluation criteria; Content, Analytical skills, Reasoning skills, Organisation skills, Communication skills, Creativity, Listening skill, Leadership quality, Body language, Group behavior.
12. Facing an interview; presentation of scientific papers Research, Practice, Dress Well, Be Punctual and Prepared, Wait Actively, First Impression, Don't Stress, Introduce Yourself Professionally. Podium Presentation, Appropriate Conference, Make a Plan, Prepare the Abstract, Content for Slides and Speech, Practice and Time your Speech, Familiarize with the Hall and the Audio-Visual System, Delivering the Presentation.

Recommended Text Books/ Reference Books

1. MLA Handbook for writers of Research Papers- Joseph G. 2000. 5th Ed. Affiliated East- West Press.
2. Comp. Oxford Advanced Learner's Dictionary of Current English- Hornby AS. 2000. 6th Ed. Oxford University Press.
3. Technical Writing- Gordon HM & Walter JA. 1970. 3rd Ed. Holt, Rinehart & Winston.
4. Handbook for Technical Writing- James HS. 1994. NTC Business Books.
5. Speaking English Effectively- Mohan K. 2005. MacMillan India.
6. Course in Phonetics and Spoken English- Abhishek. Sethi J & Dhamija PV. 2004. 2nd Ed. Prentice Hall of India.
7. Technical Writing- Richard WS. 1969. Barnes & Noble.
8. High School English Grammar and Composition- Wren PC & Martin H. 2006. S. Chand & Co.
9. Spoken English; Flourish Your Language- Robert C. (Ed.). 2005.

JOURNALS:

1. Indian Journal of Agronomy(https://www.ijaronline.com)
2. International Journal of Agronomy](https://www.hindawi.com/journals/ijagr/)
3. Agronomy Journal](https://acsess.onlinelibrary.wiley.com/journal/14350645)

4. Field Crops Research](https://www.journals.elsevier.com/field-crops-research)
5. Crop Science (https://acsess.onlinelibrary.wiley.com/journal/14350653)
6. European Journal of Agronomy (https://www.journals.elsevier.com/european-journal-of-agronomy)
7. Journal of Agronomy and Crop Science (https://onlinelibrary.wiley.com/journal/1439037x)
8. Agricultural Systems (https://www.journals.elsevier.com/agricultural-systems)
9. Journal of Agricultural and Food Chemistry (https://pubs.acs.org/journal/jafcau)
10. Journal of Soil and Water Conservation (https://www.jswconline.org)