

Faculty of Agriculture

RKDF University, Bhopal

B. Sc. (Hons.) Agriculture

Sixth Dean's Syllabus

First Semester

S. No.	Subject Name	Subject Code	Credit Hours
1.	Deeksharambh (Induction cum Foundation course) (Non-Gradial)	DRM-101	2(0+2)
2.	Biofertilizer and Biopesticide Production	SEC-101	2(0+2)
3.	Post-harvest Processing Technology	SEC-102	2(0+2)
4.	Communication Skills	EXT-101	2(1+1)
5.	Farming based livelihood systems	AGRO-101	3(2+1)
6.	Rural Sociology and Educational Psychology	EXT-102	2 (2+0)
7.	Fundamentals of Agronomy	AGRO-102	3(2+1)
8.	Fundamentals of Soil Science	SOIL-101	3(2+1)
9.	Fundamentals of Horticulture	HORT-101	3(2+1)
10.	NSS-I/ NCC-I	NSS-101	1(0+1)
11.	Introductory mathematics (Non-Gradial)	STAT-101	1(1+0)

Syllabus

Deeksharambh (Induction cum Foundation course) (Non-Gradial)	DRM-101	2(0+2)
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Objectives

- Help for cultural integration of students from different backgrounds,
- Know about the operational framework of academic process in the University/College/Institute
- Instilling life and social skills,
- Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
- Identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.
- Identify strength and weakness of the students in different core areas of the discipline.

The details of activities will be decided by the parent universities. The structure shall include, but not restricted to:

- i. Discussions on operational framework of academic process in the University, as well as interactions with academic and research managers of the University Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
- ii. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's

life experiences

- iii. Activities to enhance cultural Integration of students from different backgrounds.
- iv. Field visits to related fields/ establishments
- v. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills

Biofertilizer and Biopesticide Production	SEC-101	2(0+2)
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Objectives

1. To provide knowledge on principles, methods, and mechanisms of bio-control agents and their use against plant diseases
2. To provide knowledge on principles, methods, and mechanism of biofertilizers and their use in agriculture

Course Outcome:

Course outcomes of Biopesticides and Biofertilizers may include:

- Production: Students learn how to produce biofertilizers and biopesticides efficiently. They also learn how to scale up production for farmers.
- Environmental impact: Students learn how biofertilizers and biopesticides can reduce the environmental impact of chemical fertilizers.
- Soil health: Students learn how biofertilizers and biopesticides can improve soil health.
- Plant disease: Students learn how biopesticides can be used to control plant diseases.
- Soil fertility: Students learn how biofertilizers can increase soil fertility.
- Microbiological analysis: Students learn how to analyze soil samples using microbiological and physico-chemical techniques.
- Organic farming: Students learn how biofertilizers and biopesticides can be used to promote organic farming.
- Biofertilizer types: Students learn about the different types of biofertilizers and how to apply them.
- Biopesticide mode of action: Students learn how microbes act on biopesticides.

Practical

Exercise No.01: To Study about the Identification of important botanicals

Exercise No.02: To Study the Isolation and purification of Trichoderma

Exercise No.03: To Study the Isolation and purification of Pseudomonas

Exercise No.04: To Study the Isolation and purification of Bacillus

Exercise No.05: To Study the Isolation and purification of Metarhizium

Exercise No.06: To Study the Isolation and purification of Azospirillum,

Exercise No.07: To Study the Isolation and purification of Azotobactor,

Exercise No.08: To Study the Isolation and purification of Rhizobium

Exercise No.09: To Study the Isolation and purification of P-solubilizers and cyanobacteria.

Exercise No.10: Visit to bio pesticide and bio fertilizers laboratory in nearby area

Suggested readings

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society

2. Bhatnagar, R.K. and Palta, R.K. Earthworm Vermiculture and Vermicomposting. Kalyani Publishers.
3. Boland, G.J. and David, L.1998. Plant Microbe Interactions and Biological Control. Kuykendall Marel Dekker, INC.
4. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology.
5. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.

Post-harvest Processing Technology	SEC-102	2(0+2)
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Practical:

Experiment 1: Determination of Shape and size of Agricultural Produce.

Experiment 2: Determination of Porosity and void ratio.

Experiment 3: Determination of Moisture content of Agricultural Produce by Hot Air Oven Methods

Experiment 4: Determination of Moisture Content of Agricultural Produce by Indirect Method.

Experiment 5: Study of Packaging Material and different types of packaging material.

Experiment 6: Identification of equipment and machinery used is preservation of fruits and vegetables.

Experiment 7: Study of Methods of drying of fruits and vegetables.

Experiment 8: Study of Traditional Storage structure.

Experiment 9: Study of Modern Storage structure.

Experiment 10: Study of cleaning and grading equipment.

Experiment 11: Study of conveyor and Elevator

Experiment 12: Measurement of Brix Content by Hand and digital refracto-meter

Experiment 13: Determination of Ash Content.

Experiment 14: Study of Size reduction methods.

Communication Skills	EXT-101	2(1+1)
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Course Outcomes

1. Develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others.
2. Understand and practice different techniques of communication.
3. Practice and adhere to the 7Cs of Communication.
4. Familiarize with different types of Communication.
5. Understand and practice Interview Etiquettes.

Theory

Unit 1: Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication.

Unit 2: Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Unit 3: Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.

Unit 4: Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbal; phrases and clauses; Case: subjective case, possessive case; objective case;

Unit 5: Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

Practical

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

Suggested Reading

1. Allport, G. W.1937. Personality: A Psychological Interpretation. Holt, New York.
2. Brown Michele and Gyles Brandreth. 1994. How to Interview and be Interviewed. Sheldon Press, London.
3. Carnegie Dale. 1997. The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. Francis Peter S J. 2012. Soft Skills and Professional Communication. Tata McGraw Hill, New Delhi.
5. Kumar S and Pushpa Lata. 2011. Communication Skills. Oxford University Press.

Farming based livelihood systems	AGRO-101	3(2+1)
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Course Outcomes

1. To make the students aware about farming-based livelihood systems in agriculture
2. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood

Theory

Unit I: Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems.

Unit II: Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood.

Unit III: Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Small-, medium- and large-

enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones.

Unit IV: Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government.

Unit V: Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

Practical

Survey of farming systems and agricultural based livelihood enterprises, Study of components of important farming based livelihood models/ systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models, Field visit of innovative farming system models. Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors and Study of agri-enterprises involved in industry and service sectors (Value Chain Models), Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis, Case study of Start-Ups in agri-sectors.

Suggested Readings

1. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7. [Google Scholar]
2. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi, India
3. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy
4. Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO & World Bank, Rome, Italy & Washington, DC, USA
5. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy

Rural Sociology and Educational Psychology	EXT-102	2 (2+0)
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Course Outcomes

1. This course will enable students to acquire knowledge on basics concepts related to rural sociology and educational psychology.
2. Students will also learn the practical applications of important sociological and psychological concepts.
3. Provide knowledge on concept and importance of sociology and rural sociology as well as the relationship with Extension Education.

4. Understand concept of educational psychology, intelligence, personality, perceptions, emotions, frustration, motivation, teaching and learning.
5. Understand social groups, social stratification, culture, social values, social control and attitudes, leadership and training.

Theory

Unit 1: Extension Education and Agricultural Extension: Meaning, definition, scope, and importance. Sociology and rural sociology: Meaning, definition, scope, importance of rural sociology in Agricultural Extension, and interrelationship between rural sociology and Agricultural Extension. Indian Rural Society: important characteristics, differences and relationship between rural and urban societies.

Unit 2: Social Groups: Meaning, definition, classification, factors considered information and organization of groups, motivation in group formation and role of social groups in Agricultural Extension. Social Stratification: Meaning, definition, functions, basis for stratification, forms of social stratification- characteristics and- differences between class and caste system. Cultural concepts: culture, customs, folkways, mores, taboos, rituals. Traditions: Meaning, definition and their role in Agricultural Extension.

Unit 3: Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension. Social Institutions: Meaning, definition, major institutions in rural society, functions, and their role in agricultural Extension. Social Organizations: Meaning, definition, types of organizations and role of social organizations in agricultural Extension. Social Control: Meaning, definition, need of social control and means of social control.

Unit 4: Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change. Leadership: Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders. Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension, Psychology and educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension.

Unit 5: Intelligence: Meaning, definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension. Personality: Meaning, definition, types, factors influencing the personality and role of personality in agricultural Extension. Teaching: Learning process: Meaning and definition of teaching, learning, learning experience and learning situation, elements of learning situation and its characteristics. Principles of learning and their implication of teaching.

Suggested Readings:

1. A. R. Desai -Rural Sociology in India
2. Dahama O. P. and Bhatnagar, O. P. - Education and Communication for Development
3. J.B. Chitambar -Introductory Rural Sociology
4. M.B. Ghorpade- Essential of psychology
5. Prepared You Tube videos

Fundamentals of Agronomy	AGRO-102	3(2+1)
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Course Outcomes

1. In modern terminology however the word has come to mean and denote a branch of science dealing with all aspects of crop cultivation and production.
2. Knowledge about Indian Agriculture and importance, present status, scope and future prospect.
3. Cropping seasons of India. Soil formation, classification, physical, chemical properties. Identification of important crops and crop seeds.

Theory

Unit I: Agronomy and its scope: Definition, meaning and scope of Agronomy; art, science and business of crop production, relation of Agronomy with other disciplines of Agricultural Science, fields crops and classification, importance, ecology and ecosystem. Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and method of sowing: broadcasting, drilling, dibbling, transplanting etc. Tillage and tilth: Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield.

Unit II: Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /un- combined forms. Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring.

Unit III: Water management: Water resources of the world, India and the state; Soil Moisture constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants.

Unit IV: Weeds: Definition, Importance and basics of classification of weeds and their control. Agro- climatic zones of India and the state, cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country.

Unit V: Sustainable crop production: Definition, importance and practices, natural resources and conservation pollution and pollutants, Allelopathy: Meaning and importance in crop production. Growth and development of crops: Definition, Meaning and factors affecting growth and development.

Practical

A visit to Instructional Crop farm and study on field crops, Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state, Study of some preparatory tillage implements, Study of inter tillage implements,

Practice of ploughing / puddling, Study and practice of inter cultivation in field crops, Numerical exercises on calculation of seed, plant population and fertilizer requirement, Study of yield contributing characters and yield estimation of crops, Identification of weeds in different crops, Seed germination and viability test of seed, Practice on time and method of application of manures and fertilizers.

Suggested readings

1. Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
2. Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
3. Reddy, S. R. 2008. Principle of Crop Production, Kalyani Publisher, Ludhiana.
4. William L Donn. 1965. Meteorology. McGraw-Hill Book Co. New York.
5. Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, Nagpur.

Fundamentals of Soil Science	SOIL-101	3(2+1)
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Course outcome: Upon completion of the course students will be able to;

1. Students will gain knowledge on concepts and principles of Soil Science
2. Study of rocks-igneous, sedimentary and metamorphic rocks
3. Study of Soil: Pedological and edaphological concepts. Rocks and minerals, weathering, Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity).
4. Explain the soil forming process to relate to the soil forming factors in various climatic conditions.
5. List the physical properties and chemical properties that affect both plant growth and biological activity.
6. Explain soil as medium of plant growth, soil quality and soil health in relation to plant growth.
7. Explain Soil formation, Soil organic matter, Pedogenic processes, and Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils.
8. Study of Soil profile, soil texture, soil structure. Bulk density and particle density, soil consistency, soil temperature, soil air, soil water.
9. Explain Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India.

Objective: To impart knowledge on soil genesis, basic soil properties with respect to plant growth.

THEORY

UNIT I: Soil: Pedological and edaphological concepts. Rocks and minerals, weathering, Silicate clays: constitution and properties.

UNIT II: Sources of charge, ion exchange, cation and anion exchange capacity and base saturation (after buffering capacity).

UNIT III: Soil formation, Soil organic matter, Pedogenic processes, Soil colloids: inorganic and organic, Properties of soil colloids and Ion exchange in soils.

UNIT IV: Soil profile, soil texture, soil structure, Bulk density and particle density, soil consistency, soil temperature, soil air, soil water.

UNIT V: Soil reaction and buffering capacity. Soil taxonomy, keys to soil orders. Soils of India.

PRACTICAL

1. Study of general properties of minerals, study of minerals-silicate and non-silicate minerals.
2. Study of rocks-igneous, sedimentary and metamorphic rocks.
3. Study of a soil profile, collection and processing of soil for analysis.
4. Study of soil texture-feel method, mechanical analysis.
5. Determination particle density and soil porosity.
6. Determination of soil colour.
7. Study of soil structure and aggregate analysis.
8. Determination of soil moisture.
9. Determination of soil moisture constants field capacity; water holding capacity.
10. Study of infiltration rate of soil.
11. Determination of pH and Electrical conductivity of soil.

Suggested readings

1. Introductory Soil Science – By Dilip Kumar Das, Kalyani Publishers
2. Soil Fertility and Nutrient Management – By S. S. Singh, Kalyani Publishers
3. Soil Fertility and Fertilizers – By Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The Nature and Properties of Soils – By Harry O. Buckman and Nyle C.

Fundamentals of Horticulture	HORT-101	3(2+1)
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Course Outcomes:

1. To provide knowledge on different branches of horticulture viz. pomology, olericulture, floriculture and landscaping, spices and medicinal plants
2. To provide knowledge on orchard management, propagation methods, cultural operations and nutrient management of horticultural crops
3. To provide knowledge on different physiological aspects of horticultural crops

Theory

UNIT I: Horticulture: Its different branches, importance and scope, Horticulture and botanical classification, soil and climate for horticultural crops.

UNIT II: Plant propagation: methods and propagation structures, seed dormancy and seed germination, Merits and demerits of sexual and asexual propagation Stock-scion relationship.

UNIT III: Principles of orchard establishment, principles and methods of training and pruning of fruit crops, Juvenility and flower bud differentiation, unfruitfulness in horticultural crops,

UNIT IV: Pollination, pollinizers and pollinators, fertilization and parthenocarpy, importance of bio regulators in horticultural crops,

UNIT V: Irrigation and its methods, Fertilizer application in horticultural crops.

Practical

Identification and nomenclature of fruit, Layout of an orchard, pit making and system of planting, Nursery raising techniques of fruit crops, Understanding of plant propagation structures, Propagation through seeds and plant parts, Propagation techniques for horticultural crops, Container, potting mixture, potting and repotting, Training and pruning methods on fruit crops, Preparation of fertilizer mixture and application, Preparation and application of PGR, Layout of different irrigation systems, Maturity studies, harvesting, grading, packaging and storage.

Suggested readings

1. Basics of Horticulture by Jitendra Singh
2. Introduction to Horticulture by N. Kumar
3. Handbook of Horticulture by ICAR

NSS-I/ NCC-I	NSS-101	1(0+1)
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1. Orientation: history, objectives, principles, symbol, badge; regular programs under NSS
2. Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.
3. NSS program activities: Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.
4. Community mobilization: Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration
5. Indian history and culture, role of youth in nation building, conflict resolution and peace- building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism
6. Citizenship, constitution, and human rights: Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community- based organizations) and society

Introductory mathematics (Non-Gradial)	STAT-101	1(1+0)
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Theory:

UNIT I: Algebra: Progressions- Arithmetic, Geometric and Harmonic Progressions. Matrices: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order by adjoint method, Properties of determinants up to 3rd order and their evaluation.

UNIT II: Differential Calculus: Definition - Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions. Application of Differentiation- Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue.

UNIT III: Partial differentiation: Homogeneous function, Euler's theorem, Maxima and Minima of the functions of the form $y = f(x)$ and $y = f(x_1, x_2)$.

UNIT IV: Integral Calculus: Integration -Definite and Indefinite Integrals-Methods- Integration by substitution, Integration by parts. Area under simple well-known curves.

UNIT V: Mathematical Models: Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data.

SECOND SEMESTER

S. No.	Subject Name	Subject Code	Credit Hours
1.	Mushroom Production Technology	SEC-201	2(0+2)
2.	Organic Production Technology	SEC-202	2(0+2)
3.	Personality Development	EXT-201	2(1+1)
4.	Environmental Studies and Disaster Management	AMT-201	3(2+1)
5.	Soil Fertility Management	SOIL-201	3(2+1)
6.	Fundamentals of Entomology	ENT-201	3(2+1)
7.	Livestock and Poultry Management	LPM-201	2(1+1)
8.	Fundamentals of Plant Pathology	PATH-201	3(2+1)
9.	NCC-II/NSS-II	NSS-201	1(0+1)

Syllabus

Mushroom Production Technology	SEC-201	2(0+2)
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Practical

Unit-1: Mushroom- History; Edible and non-edible mushroom; Life cycle; Morphology ; Classification of Mushroom; Factor affecting for mushroom cultivation; varieties of Edible mushrooms in India; Importance of mushroom.

Unit-2: Mushroom and their properties-Physiological properties; Medicinal properties; Nutraceuticals metabolites of mushroom(Carbohydrate, Proteins, Essential Amino acids, Fat, Vitamins, Fibre, Minerals); Side effects of mushroom.

Unit-3: Techniques for growing mushroom-Organic method for mushroom cultivation; Chemical method for mushroom cultivation; preparation of culture(Pure culture, mother culture, slant preparation); Preparation of spawn; Different spawning method; Crop

management; Irrigation methods; different methods of compost preparation for button mushroom.

Unit-4: Harvesting method; different methods of storage; Canning; Drying; Selling and marketing; Mushroom Products-Mushroom powder, cookies, pickle, Biscuit, cake, noodles, namkeen, papad and mushroom recipes.

Unit-5: Diseases of mushroom and their management-Source of disease, Spread of disease, Bacterial diseases, Fungal diseases, Viral diseases, Insect and other pests, Prevention during and after cropping by organic and chemical methods, control measure by organic method and chemical methods.

Organic Production Technology	SEC-202	2(0+2)
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Practical

Experiment: 1 Field visit to organic farms to study the various components and their utilization

Experiment: 2 Methods of compost preparation in organic farming

Experiment: 3 Application and method of vermicompost preparations

Experiment: 4 What is biofertilizer. How to treatments of seed and seedling with biofertilizers

Experiment: 5 Green manuring in organic farming

Experiment: 6 Indigenous technology for nutrient management in organic farming

Experiment: 7 Indigenous technology for weed management practice in organic farming

Experiment: 8 Study of Indigenous Technology Knowledge for insect and diseases management

Experiment: 9 Quality aspects of grading, packaging and handling of organic produce

Experiment: 10 Current Government schemes related to organic farming

Experiment:11 Quality analysis of compost and vermicompost

Personality Development	EXT-201	2(1+1)
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Course Outcomes

1. To make students realize their potential strengths, cultivate their inter-personal skills and improve employability.
2. The student will be able to understand, analyse develop and exhibit accurate sense of self.
3. Think critically.
4. Demonstrate knowledge of personal beliefs and values and a commitment to continuing personal reflection and reassessment.
5. Learn to balance confidence with humility and overcome problems associated with personality.

Theory

Unit 1: Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality

Unit 2: Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviors, personality and Organizational Behavior.

Unit 3: Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution.

Unit 4: Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback.

Unit 5: Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

Practical

MBTI personality analysis, Learning Styles and Strategies, Motivational needs, Firo-B, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behavior.

Suggested Reading

1. Andrews, Sudhir. 1988. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw- Hill.
2. Heller, Robert. 2002. Effective Leadership. Essential Manager series. Dk Publishing.
3. Hindle, Tim. 2003. Reducing Stress. Essential Manager series. Dk Publishing.
4. Lucas, Stephen. 2001. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
5. Mile, D.J. 2004. Power of Positive Thinking. Delhi. Rohan Book Company.

Environmental Studies and Disaster Management	AMT-201	3(2+1)
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Objective:

To expose and acquire knowledge on the environment and to gain the state-of-the-art - skill and expertise on management of disasters.

Course outcome:

1. Understanding environmental issues: Students learn about the consequences of human actions on the environment, and how to analyze real-world problems.
2. Adopting sustainable practices: Students learn how to adopt sustainable practices in their personal lives, in society, and in industry.
3. Understanding the role of organizations: Students learn how organizations can play a role in environmental management.
4. Understand the consequences of human actions: how human actions affect the web of

life, global economy, and quality of human life.

5. Gain knowledge on Environment: its structure, climate change, sustainable development, disaster management, different type of diseases and public health management

Theory

Unit I- Introduction to Environment - Environmental studies: Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth- Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere.

Unit II- Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity.

Unit III- Environmental Pollution: Definition, cause, effects and control measures of:

- a. Air Pollution , b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution h. Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes.

Unit IV- Social Issues and the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.

Unit V- Disaster management: Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

Practical

1. Visit to a local area to document environmental assets river/forest/grassland/hill/mountain.
2. Biogas production from organic wastes. Visit to wind mill / hydro power / solar power generation units.
3. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and unpolluted system.

4. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds.
5. Water quality analysis: pH, EC and TDS.
6. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples.
7. Estimation of COD in water samples.
8. Enumeration of E. coli in water sample.
9. Assessment of Suspended Particulate Matter (SPM).
10. Study of simple ecosystem
11. Visit to pond/river/hills.
12. Visit to areas affected by natural disaster.

Suggested Readings

1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13-978 81 224 2617 5. 384 pp
2. Dhar Chakrabarti, P.G. 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi

Soil Fertility Management	SOIL-201	3(2+1)
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Objective- To provide a comprehensive knowledge of soil fertility, plant nutrition, fertilizers, and nutrient management.

Course outcome:

1. Understanding Soil Properties: Students will demonstrate an understanding of the physical, chemical, and biological properties of soil and their impact on fertility.
2. Nutrient Cycling: Students will comprehend nutrient cycling processes in soil, including the roles of macro and micronutrients.
3. Fertilizer Knowledge: Students will identify and explain the properties, benefits, and environmental impacts of organic and inorganic fertilizers.
4. Soil Testing and Analysis: Students will be able to perform soil tests and interpret results to assess soil fertility and nutrient needs.
5. Fertility Planning: Students will develop soil fertility management plans tailored to specific crop needs and environmental conditions.
6. Problem-Solving Skills: Students will address soil fertility issues by proposing scientifically-based solutions to improve crop yields.

Theory

UNIT I: History of soil fertility and plant nutrition. Criteria of essentiality. role, deficiency and toxicity symptoms of essential plant nutrients, Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants.

UNIT II: Chemistry of macro and micronutrients. Soil fertility evaluation, Soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests.

UNIT III: Indicator plants. Introduction and importance of manures and fertilizers. Fertilizer recommendation approaches. Integrated nutrient management.

UNIT IV: Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customized fertilizers, water soluble fertilizers nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.

UNIT V: Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading, Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes).

Practical

1. Introduction of analytical instruments and their principles.
2. Calibration and applications of Coloremety and flame photometry.
3. Estimation of alkaline hydrolysable N in soils.
4. Estimation of soil extractable P in soils.
5. Estimation of exchangeable K in soils.
6. Estimation of exchangeable Ca and Mg in soils.
7. Estimation of soil extractable S in soils.
8. Estimation of DTPA extractable Zn in soils.
9. Estimation of N in plants.
10. Estimation of P in plants.
11. Estimation of K in plants.
12. Estimation of S in plants.

Suggested readings

1. Introductory Soil Science by Dilip Kumar Das, Kalyani Publishers
2. Soil Fertility and Nutrient Management by S. S. Singh, Kalyani Publishers
3. Soil Fertility and Fertilizers by Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
4. The nature and Properties of Soils by Harry O. Buckman and Nyle C.

Fundamentals of Entomology	ENT-201	3(2+1)
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Course Outcomes:

1. To know the history of entomology, classification of insects and their relationship with other arthropods
2. To study the various morphological characters of class insect and their importance for classification of insects
3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects

4. To study the characteristics of commonly observed insect orders and their economically important families

Theory:

UNIT-I: History of Entomology in India. Major points related to dominance of Insects in Animal kingdom. Classification of phylum Arthropoda up to classes. Relationship of class Insects with other classes of Arthropoda.

UNIT-II: Morphology: Structure and functions of insect cuticle and molting. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts, legs, Wing venation, modifications and wing coupling apparatus. Metamorphosis and diapause in insects. Types of larvae and pupae.

UNIT-III: Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine) and reproductive system, in insects. Types of reproduction in insects. Major sensory organs.

UNIT-IV: Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors and biotic factors. Categories of pests. Systematics: Taxonomy – importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order.

UNIT-V: Classification of class Insecta up to Orders, basic groups of present day insects with special emphasis to orders and families of Agricultural importance like Orthoptera: Acrididae, Tettigoniidae, Gryllidae, Gryllotalpidae; Dictyoptera: Mantidae, Blattidae; Odonata; Isoptera: Termitidae; Thysanoptera: Thripidae; Hemiptera: Pentatomidae, Coreidae, Cimicidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Lophophidae, Aleurodidae, Pseudococcidae; Neuroptera: Chrysopidae; Lepidoptera: Pieridae, Papilionidae, Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae, Saturniidae, Bombycidae; Coleoptera: Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera: Tenthredinidae, Apidae. Trichogrammatidae, Ichneumonidae, Braconidae, Chalcididae; Diptera: Cecidomyiidae, Tachinidae, Agromyziidae, Culicidae, Muscidae, Tephritidae.

Practical

Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Dissection of digestive system in insects (Grasshopper); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Insecticides and their formulations. Pesticide appliances and their maintenance. Sampling techniques for estimation of insect population and damage.

Suggested readings

1. Fundamentals of Ecology - Eugene. P. Odum and Gray W. Barrett
2. Imm's General Text book of Entomology— O.W. Rechards and R.G. Davies
3. Introduction to the study of Insects –D. J. Borror and DeLong's

Livestock and Poultry Management	LPM-201	2(1+1)
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Course Outcomes:

1. Provide basic knowledge to the students about scientific livestock and poultry rearing practices
2. Entrepreneurship development through Livestock/poultry and Agriculture Integrated Farming System

Theory

Unit I: Role of livestock in the national economy. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry. Management of calves, growing heifers and milch animals.

Unit II: Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers.

Unit III: Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry. Digestion in livestock and poultry.

Unit IV: Classification of feedstuffs. Proximate principles of feed. Nutrients and their functions. Feed ingredients for ration for livestock and poultry. Feed supplements and feed additives.

Unit V: Feeding of livestock and poultry. Introduction of livestock and poultry diseases. Prevention (including vaccination schedule) and control of important diseases of livestock and poultry.

Practical

External body parts of cattle, buffalo, sheep, goat, swine and poultry. Handling and restraining of livestock. Identification methods of farm animals and poultry. Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records. Judging of cattle, buffalo and poultry. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Formulation of concentrate mixtures. Clean milk production, milking methods. Hatchery operations, incubation and hatching equipment. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production.

Suggested Readings

1. A Textbook of Animal Husbandry by G. C Banerjee
2. A text Book of Livestock Production management in Tropic by D. N. Verma

Fundamentals of Plant Pathology	PATH-201	3(2+1)
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Course Outcomes

1. To get acquainted with the role of different microorganisms in the development of plant disease.
2. To get general concepts and classification of plant diseases.

3. To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganisms causing plant diseases.
4. To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases.
5. To get acquainted with various plant disease management principles and practices.

Theory

Unit-I Introduction to Plant Pathology: Concept of disease in plants; Different terms used in Plant Pathology.

Unit-II History of Plant Pathology with special references to India. Causes of plant disease: Inanimate and animate causes; Classification of plant disease; Parasitism and pathogenesis; Development of disease in plants: Disease Triangle, Disease cycle.

Unit-III Fungi and their morphology, reproduction and classification of fungi; Bacteria: Morphology, reproduction classification of phytopathogenic

Unit-IV bacteria; Other plant pathogens: Mollicutes; Flagellant protozoa; FVB; Green algae and parasitic higher plants; Viruses and viroids, virus transmission;

Unit-V Principles of Plant disease management: Disease management with chemicals, Host resistance, cultural and biological method of Integrated Disease Management (IDM).

Practical

Study of the microscope; Acquaintance with laboratory material and equipment; Study of different plant disease symptoms; Microscopic examination of general structure of fungi; Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria; Microscopic examination of fungal diseased specimen; Microscopic examination of bacterial diseased specimen; Preparation of culture media; Isolation of plant pathogens: Fungi, bacteria and viruses; Purification of plant pathogens; Study on plant disease diagnosis: Koch's Postulates, Characteristics, formulation, methods of application and calculation on fungicides.

Suggested readings

1. Agrios, G.N. 2010. Plant Pathology. Acad. Press.
2. Alexopoulos, Mims and Blackwel. Introductory Mycology.
3. Dhingra, O.D. and Sinclair, J.B. 1986. Basic Plant Pathology Methods. CRC Press, London, Tokyo.
4. Gibbs, A. and Harrison, B. 1976. Plant Virology - The Principles. Edward Arnold, London
5. Goto, M. 1990. Fundamentals of Plant Bacteriology. Academic Press, New York.

NCC-II/NSS-II	NSS-201	1(0+1)
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1. Importance and role of youth leadership
2. Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies
3. Definition and importance of life competencies, problem-solving and decision-making
4. Interpersonal communication. Youth development programs
5. Development of youth programs and policy at the national level, state level and

voluntary sector; youth-focused and youth-led organizations

6. Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

Third Semester

S. No.	Subject Name	Subject Code	Credit Hours
1.	Food Processing	SEC-301	2(0+2)
2.	Entrepreneurship Development and Business Communication	ECO-301	3 (2+1)
3.	Physical Education, First Aid, Yoga Practices and Meditation	PHY-301	2(0+2)
4.	Principles of Genetics	GPB-301	3(2+1)
5.	Crop Production Technology-I (Kharif crops)	AGRO-301	3(1+2)
6.	Production Technology of Fruit and Plantation Crops	HORT-301	2 (1+1)
7.	Fundamentals of Extension Education	EXT-301	2(1+1)
8.	Fundamentals of Nematology	NMT-301	2(1+1)
9.	Principles and Practices of Natural Farming	AGRO-302	2(1+1)

Syllabus

Food Processing	SEC-301	2(0+2)
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Practical:

- Experiment No. 1: Study of preparation of Jam
- Experiment No. 2: Study of preparation of jelly
- Experiment No. 3: Study of preparation of
- Experiment No. 4: Preservation by High Concentration of Sugar (Fruit Preserve)
- Experiment No. 5: Preservation by Salt (Pickling)
- Experiment No. 6: Preservation by using Chemical Preservative
- Experiment No. 7: Drying and dehydration of fruit
- Experiment No. 8: Drying and dehydration of vegetables
- Experiment No. 9: Preservation by fermentation.
- Experiment No. 10: Preparation of Bakery Products.
- Experiment No. 11: Preservation by boiling (pasteurization and sterilization)
- Experiment No. 12: Reconstitution Test for dried Vegetable Sample.
- Experiment No. 13: Drying and Dehydration by solar Dryer
- Experiment No. 14: Value addition of Pulses
- Experiment No. 15: Value Addition of Cereals

Entrepreneurship Development and Business Communication	ECO-301	3 (2+1)
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Course Outcomes

1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small business unit
3. To enable the student to develop financially viable agribusiness proposal

Theory

Unit 1: Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development.

Unit 2: Environment scanning and opportunity identification need for scanning: spotting of opportunity, scanning of environment identification of product / service: starting a project; factors influencing sensing the opportunities. Infrastructure and support systems: good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise.

Unit 3: Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management: product, levels of products, product mix, quality control, cost of production, production controls, Material management.

Unit 4: Production management: raw material costing, inventory control. Personal management: manpower planning, labour turn over, wages / salaries. Financial management /accounting: funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation.

Unit 5: Marketing management: market, types, marketing assistance, market strategies. Crisis management: raw material, production, leadership, market, finance, natural etc.

Practical

Visit to small scale industries/agro-industries, Interaction with successful entrepreneurs/ agric- entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Suggested Readings:

1. Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.

2. Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
3. Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.
4. Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.

Physical Education, First Aid, Yoga Practices and Meditation	PHY-301	2(0+2)
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Objectives

- i) To make the students aware about Physical Education, First Aid and Yoga Practices
- ii) To disseminate the knowledge and skill how to perform physical training, perform first aid and increase stamina and general wellbeing through yoga

Practical

Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and anaerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.

Yoga; History of Yog, Types of Yog, Introduction to Yog,

- Asanas (Definition and Importance) Padmasana, Vajrasana, Shashankasana, Pashchimotana, Ushtrasana, Tadasana, Padhasana, Ardha Chandrasana, Bhujangasana, Utanpadasana, Sarvangasana, Parvatasana, Patangasana, Shishupalasana – left leg-right leg, Pawanmuktasana, Halasana, Sarpasana, Ardha Dhanurasana, Sawasana
- Suryanamskara Pranayama (Definition and Importance) Omkar, Suryabhedana, Chandrabhedana, Anulom Viloma, Shitali, Shitkari, Bhastrika, Bhramari
- Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandha
- Mudras (Definition and Importance) Gyanmudra, Dhyana mudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanamudra
- Role of yoga in sports
- Teaching of Asanas – demonstration, practice, correction and practice.

History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics

Need and requirement of first aid. First Aid equipment and upkeep. First aid Techniques, First aid related with Respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

Principles of Genetics	GPB-301	3(2+1)
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Course Outcome

CO 1. Apply the knowledge gained on inheritance and variation

CO 2. Study about structure and working of chromosomes

CO 3. Relate mutation to evolution and heredity

CO 4. Interpret the functions of genetic material.

Theory

Unit 1: Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Study of model organisms (Drosophila, Arabidopsis, Garden pea, E. coli, and mice)

Unit 2: Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis. Probability and Chi-square. Types of DNA and RNA, Dominance relationships, Epistatic interactions with example, Introduction and definition of cytology, genetics and cytogenetics and their interrelation

Unit 3: Multiple alleles, pleiotropism and pseudoalleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics, Linkage and its estimation, crossing over mechanism, chromosome mapping, Structural and numerical variations in chromosomes and their implications

Unit 4: Use of haploids, dihaploids and double haploids in Genetics, Mutation, classification, Methods of inducing mutations, mutagenic agents and induction of mutation. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance

Unit 5: Nature, structure and replication of genetic material, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation

Practical

Study of microscope, Study of cell structure, Mitosis and Meiosis cell division, Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and chi-square test, Determination of linkage and cross-over analysis (through two point test cross data), Study on sex linked inheritance in Drosophila. Study on models on DNA and RNA structures.

Suggested readings

1. Fundamentals of Genetics: B. D. Singh
2. Genetics: M. W. Strickberger.
3. Principles of Genetics: Gardner, Simmons and Snustad.
4. Principles of Genetics: Sinnott, Dunn and Dobzhansky

Crop Production Technology-I (Kharif crops)	AGRO-301	3(1+2)
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Course Outcome

CO1-To impart basic and fundamental knowledge on principles and practices of kharif crop production

CO 2-To impart knowledge and skill on scientific crop production and management.

Theory

Unit I: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Kharif crops.

Unit II: Cereals- rice, maize, sorghum, pearl millet, finger millet and other minor millets.

Unit III: Pulses- pigeon pea, mungbean and urdbean.

Unit IV: Oilseeds-groundnut, soybean, sesame, castor; fibre crops- cotton and jute.

Unit V: Forage crops- sorghum, cowpea, cluster bean, maize, guinea and napier.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeon pea and mungbean, maize, groundnut and cotton, effect of seed size on germination and seedling vigour of Kharif crops, effect of sowing depth on germination of Kharif crops, identification of weeds in Kharif crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of Kharif crops, study of crop varieties and important agronomic experiments at experiential farm, recording biometric observations, Study of forage experiments, morphological description of Kharif crops, silage and hay making, visit to research centres of related crops.

Suggested Readings

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidida Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
4. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
5. S.S. Singh. 2005. Crop Management. Kalyani Publishers, New Delhi.

Production Technology of Fruit and Plantation Crops	HORT-301	2 (1+1)
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Course Outcomes:

1. To educate about the different forms of classification of fruit crops
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of fruit and plantation crops
3. To educate about the physiological disorders of fruit crops, palms and plantation crops

Theory

Unit I: Production status of fruit and plantation crops: Importance and scope of fruit and plantation crop industry in India; nutritional value of fruit crops; classification of fruit crops; area, production, productivity and export potential of fruit and plantation crops.

Unit II: Crop production techniques in tropical, sub-tropical and temperate fruit crops: Climate and soil requirements, varieties, propagation and use of rootstocks, planting density and systems of planting: High density and ultra-high density planting, cropping systems, after care – training and pruning; water, nutrient and weed management, fertigation, special horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.

Unit III: Fruit crops: mango, banana, papaya, guava, sapota, citrus, grape, litchi, pineapple, pomegranate, apple, pear, peach, strawberry, nut crops Jackfruit and minor fruits- date, ber, apple, plantation crops-coconut, arecanut, cashew, tea, coffee and rubber.

Unit IV: Crop production techniques in palms and plantation crops: Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition

Unit V: Palms: Coconut, Arecanut, Oil palm and Palmyrah, Plantation crops: Tea, Coffee, Cocoa, Cashewnut, Rubber.

Practical

Propagation techniques, selection of planting material, varieties, important cultural practices for mango, banana, papaya, guava, sapota, grapes, Citrus (mandarin and acid lime), pomegranate, jackfruit, preparation and application of PGR's for propagation, Micro propagation, protocol for mass multiplication and hardening of fruit crops, Identification and description of varieties, mother palm and seed nut selection, nursery practices, seedling selection, fertilizers application, nutritional disorders, pests and diseases of Coconut, Arecanut and cocoa, Tea and coffee, Rubber and cashew, Visit to commercial orchard and plantation industries.

Suggested Readings

1. Banday, F.A. and Sharma, M.K. 2010 Advances in temperate fruit production. Kalyani Publishers, Ludhiana

2. Bose, T.K., S.K. Mitra and D. Sanyal 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.
3. Bose, T.K., S.K. Mitra, A.A. Farooqi and M.K. Sadhu (Eds). 1999. Tropical Horticulture Vol.1. Naya Prokash, Calcutta.
4. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
5. Chadha, T.R. 2001 Textbook of temperate fruits. ICAR, New Delhi

Fundamentals of Extension Education	EXT-301	2(1+1)
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Course Outcomes

1. State the importance of extension education in agriculture
2. Familiarize with the different types of agriculture and rural development programs launched by govt. of India
3. Classify the types of extension teaching methods
4. Elaborate the importance and different models of communication
5. Explain the process and stages of adoption along with adopters' categories

Theory

Unit 1: Education: Meaning, definition and Types; Extension Education: meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning: Meaning, Process, Principles and Steps in Programme Development.

Unit 2: Extension systems in India: extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). Social Justice and poverty alleviation programme: ITDA, IRDP/SGSY/NRLM. Women Development Programme: RMK, MSY etc.

Unit 3: New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc., Attributes of Innovation, DW CRA, Commodity Interest Groups (CIGs), Farmers Producer Group (FPG). Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India. Community Development: meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Method of identification of Rural Leader.

Unit 4: Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs; Transfer of technology: concept and models, capacity building of extension personnel.

Unit 5: Extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and social media), media mix strategies; Communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; Diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories.

Practical

To get acquainted with university extension system. Group discussion- exercise; Identification of rural leaders in village situation; preparation and use of AV aids, preparation of extension literature (leaflet, booklet, folder, pamphlet news stories and success stories); Presentation skills exercise; micro teaching exercise; A visit to village to understand the problems being encountered by the villagers/ farmers; to study organization and functioning of DRDA/PRI and other development departments at district level; visit to NGO/FO/FPO and learning from their experience in rural development; understanding PRA techniques and their application in village development planning; exposure to mass media: visit to community radio and television studio for understanding the process of programme production; script writing, writing for print and electronic media, developing script for radio and television.

Suggested Reading

1. Adivi Reddy, A. 2001. Extension Education, Sree Lakshmi press, Bapatla.
2. Dahama, O. P. and Bhatnagar, O.P. 1998. Education and Communication for Development, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
3. Jaliha, K. A. and Veerabhadraiah, V. 2007. Fundamentals of Extension Education and Management in Extension, Concept publishing company, New Delhi.
4. Muthaiah Manoraharan, P. and Arunachalam, R., Agricultural Extension, Himalaya Publishing House (Mumbai).
5. Sagar Mondal and Ray, G. L., Text Book on Rural Development, Entrepreneurship and Communication Skills, Kalyani Publications.

Fundamentals of Nematology	NMT-301	2(1+1)
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Course outcomes

1. Learn about the mouth, lips, stoma, and esophagus of nematodes.
2. Learn about the nervous system of nematodes, including the nerve ring, longitudinal nerve cord, and ganglia.
3. Learn about the feeding activity of nematodes.

Theory

Unit-I: Introduction: History of phytonematology, habitat and diversity, economic importance of nematodes. General characteristics of plant parasitic nematodes.

Unit-II: Nematode: definition, general morphology and biology. Classification of nematodes up to family level with emphasis on groups containing economically important genera. Classification of nematodes on the basis of feeding/ parasitic habit.

Unit-III: Symptomatology, role of nematodes in disease development, Interaction between plant parasitic nematodes and disease-causing fungi, bacteria and viruses.

Unit-IV: Nematode pests of crops: Rice, wheat, vegetables, pulses, oilseed and fiber crops, citrus and banana, tea, coffee and coconut.

Unit-V: Different methods of nematode management: Cultural methods, physical; methods, Biological methods, Chemical methods, Plant Quarantine, Plant resistance and INM.

Practical

Sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following Cobb's sieving and decanting technique, Baermann funnel technique, Picking and counting of plant parasitic nematode. Identification of economically important plant nematodes up to generic level with the help of keys and description: Meloidogyne, Pratylenchus; Heterodera, Tylenchulus, Xiphinema, and Helicotylenchus etc. Study of symptoms caused by important nematode pests of cereals, vegetables, pulses, plantation crops etc. Methods of application of nematicides and organic amendments.

Suggested readings

1. Economic Nematology-Edited by J.M. Webster
2. Plant Parasitic Nematodes (Vol-1) by Zukerman, Mai, Rohde
3. Plant Parasitic Nematodes of India: Problems and Progress by - Gopal Swarup, D. R. Dasgupta, P. K. Koshy.
4. Text book on Introductory Plant Nematology -R.K. Walia and H.K. Bajaj.

Principles and Practices of Natural Farming	AGRO-302	2(1+1)
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Course Outcomes:

CO1-To provide comprehensive understanding and knowledge to students about natural farming.

CO2-To teach students the concept, need and principles of native ecology-based production under natural farming.

CO3-To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives.

Theory

Unit I: Indian Heritage of Ancient Agriculture, History of Natural Farming, Importance of natural farming in view of climate change, soil health, water use carbon sequestration, biodiversity conservation, food security and nutritional security, and sustainable development goals (SDGs).

Unit II: Concept of natural farming; Definition of natural farming; Objective of natural farming, Essential characteristics and Principles of natural farming; Scope and importance of natural farming. Main Pillars of natural farming; Methods/ types/schools of natural farming.

Unit III: Characteristics and design of a natural farm, Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems, Introduction to concept of ecological, water, carbon and nitrogen foot prints, Concept and evaluation of ecosystem services, integration of crops, trees and animals, cropping system approaches, Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches on a natural farm, Rearing practices for animals under natural farming.

Unit IV: Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming; Mechanization in natural farming, Processing,

labelling, economic considerations and viability, certification and standards in natural farming, marketing and export potential of natural farming produce and products.

Unit V: Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture, Case studies and success stories in natural farming and chemical free traditional farming, Entrepreneurship opportunities in natural farming.

Practical

Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm; Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management; On-farm inputs preparation methods and protocols, Studies in green manuring in-situ and green leaf manuring, Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient, insect and pest and disease management; Weed management practices in natural farming; Techniques of Indigenous seed production- storage and marketing, Partial and complete nutrient and financial budgeting in natural farming; farming; Evaluation of ecosystem services in natural farming (Crop, Field and System).

Suggested readings

1. Boeringa, R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
2. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 to 7, Indian Council of Agricultural Research, New Delhi.
3. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
4. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace
5. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system.<https://www.fao.org/3/i9037en/i9037en.pdf> Agro ecosystem Analysis for Research and Development Gordon R. Conway.1985.

Fourth Semester

S. No.	Subject Name	Subject Code	Credit Hours
1.	Agriculture Waste Management	SEC-401	2(0+2)
2.	Agricultural Informatics and Artificial Intelligence	STAT-401	3(2+1)
3.	Production Technology of Vegetables and Spices	HORT-401	2(1+1)
4.	Principles of Agricultural Economics and Farm Management	ECO-401	2(2+0)
5.	Crop Production Technology-II (Rabi Crops)	AGRO-401	3(1+2)
6.	Farm Machinery and Power	AE-401	2 (1+1)
7.	Water Management	AGRO-402	2 (1+1)

8.	Problematic Soils and their management	SOIL-401	2(1+1)
9.	Basics of Plant Breeding	GPB-401	3(2+1)

Syllabus

Agriculture Waste Management	SEC-401	2(0+2)
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Practical Syllabus

- Experiment: 1 Importance of waste management in agriculture
Experiment: 2 Agriculture waste: meaning, source and effects
Experiment: 3 Classification of agricultural waste
Experiment: 4 Process flow of agriculture waste management system
Experiment: 5 Sustainable approaches for agriculture waste management
Experiment: 6 Agriculture waste management by vermicompost
Experiment: 7 Agriculture waste management by composting
Experiment: 8 Crop residues Management by agriculture waste
Experiment: 9 Recycling of animal waste in agriculture
Experiment: 10 Reducing post-harvest wastage

Agricultural Informatics and Artificial Intelligence	STAT-401	3(2+1)
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Course Outcomes:

1. To acquaint student with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
2. To provide basic knowledge of computer with applications in Agriculture
3. To make students familiar with Agricultural-Informatics, its components and applications in agriculture

Theory

Unit I: Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database, concepts and types, creating data base, Uses of DBMS in Agriculture. Internet and World Wide Web (WWW): Concepts and components.

Unit II: Computer programming: General concepts, Introduction general programming concepts. Concepts and standard input/output operations. e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture.

Unit III: Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops, Computer-controlled

devices (automated systems) for Agri-input management. Smartphone mobile apps in agriculture for farm advice: Market price, post-harvest management etc.

Unit IV: Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information. Decision support systems: Concepts, components and applications in Agriculture. Agriculture Expert System, Soil Information Systems etc., for supporting farm decisions. Preparation of contingent crop- planning and crop calendars using IT tools. Digital India and schemes to promote digitalization of agriculture in India.

Unit V: Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.

Practical

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/Linux, creating files and folders, File Management .Use of MS-Word and MS Power-point for creating, editing and presenting a scientific documents, MS-EXCEL-Creating a spreadsheet, Use of statistical tools, Writing expressions, Creating graphs, Analysis of scientific data, MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smartphones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial technology, AR/ VR demonstration, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Suggested Readings

1. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
2. Fundamentals of Computer by V. Rajaroman.
3. Introduction to Information Technology by Pearson.
4. Introduction to Database Management System by C. J. Date.
5. Introductory Agri-Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.

Production Technology of Vegetables and Spices	HORT-401	2(1+1)
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Course Outcomes:

1. To educate about the different forms of classification of vegetables
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of vegetables and spices
3. To educate about the physiological disorders of vegetables and spices

Theory

Unit I: Importance of vegetables and spices in human nutrition and national economy, kitchen gardening,

Unit II: Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important of vegetable like: tomato, okra, brinjal, chili, capsicum, cucumber, bitter gourd, bottle gourd, sweet potato, cassava and moringa, pumpkin, French bean, peas.

Unit III: Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important of cole crops such as cabbage, cauliflower, knol-khol; bulb crops such as onion, garlic; root crops such as carrot, radish, beetroot; tuber crops such as potato.

Unit IV: Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important of leafy vegetables such as amaranth, palak, perennial vegetables,

Unit V: Brief about origin, area, climate, soil, improved varieties and cultivation practices such as time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of important of spice crops like turmeric, zinger, garlic, coriander, cumin, black pepper, cardamom, fenugreek, fennel, clove, nutmeg, cinnamon, curry leaf, tamarind and herbal spices.

Practical

Identification of vegetables and spice crops and their seeds. Description of varieties. Propagation methods - rapid multiplication techniques - seed collection and extraction. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables and spices. Fertilizers applications. Harvesting and post-harvest practices, Economics of vegetables and spices cultivation, visit to spice gardens.

Suggested readings

1. Olericulture, Fundamentals of Vegetable Production (Vol.1) by K.P. Singh, Anant Bahadur
2. Vegetable crops by J. Kabir, T.K. Bose, M.G. Som
3. Vegetable crops (Production technology, Vol II) by M.S. Fagaria, B.R. Choudhury, R.S. Dhaka

Principles of Agricultural Economics and Farm Management	ECO-401	2(2+0)
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Course Outcomes

1. To aware the students about broad areas covered under agricultural Economics and farm management
2. To impart knowledge on judicious use of resources for optimum production
3. Understand the basic principles of economics including the problem of agricultural economics decision making, laws of economics and macroeconomic

concepts.

4. Studying consumer behaviors and economic decisions.
5. Gain knowledge on principles of farm management, production economics and natural resource economics in terms of their properties, externalities and management.

Theory

Unit I: Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro- and macro-economics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare.

Unit II: Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country. Demand: meaning, law of demand, demand schedule and demand curve, determinants, utility theory; law of diminishing marginal utility, equi-marginal utility principle. Consumer's equilibrium and derivation of demand curve, concept of consumer surplus.

Unit III: Elasticity of demand: concept and measurement of price elasticity, income elasticity and cross elasticity. Production: process, creation of utility, factors of production, input output relationship. Laws of returns: Law of variable proportions and law of returns to scale.

Unit IV: Cost: Cost concepts, short run and long run cost curves. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Distribution theory: meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Importance, Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programs on population control.

Unit V: Money: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, money supply, general price index, inflation and deflation. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic planning. Forms of business organizations, international trade and balance of payments. GST and its implication on Indian economy.

Suggested Readings

1. Johl, S.S. and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers
2. S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd

Crop Production Technology-II (Rabi Crops)	AGRO-401	3(1+2)
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Course Outcomes

1. To impart basic and fundamental knowledge on principles and practices of rabi

crop production.

2. To impart knowledge and skill on scientific crop production and management.

Theory

Unit I: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rabi crops.

Unit II: Cereals- wheat and barley. Pulses- chickpea, lentil, peas. Rabi redgram and, rajmash. Oilseed- rapeseed, mustard, sunflower, safflower; and linseed.

Unit III: Sugar crops-sugarcane and sugar beet.

Unit IV: Medicinal and aromatic crops- mentha, lemon grass and citronella.

Unit V: Forage crops –barseem, lucerne and oat; potato, quinoa, tobacco.

Practical:

Sowing methods of wheat and sugarcane; identification of weeds in rabi season crops; study of morphological characteristics of rabi crops; study of yield contributing characters of rabi season crops; yield and juice quality analysis of sugarcane; study of important agronomic experiments of rabi crops at experimental farms; study of rabi forage experiments; oil extraction of medicinal crops; visit to research stations of related crops.

Suggested Readings

1. B. Gurarajan, R. Balasubramanian and V. Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
2. Chidida Singh.1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Rajendra Prasad. Textbook of Field Crops Production - Commercial Crops. Volume II ICAR Publication.
4. Rajendra Prasad. Textbook of Field Crops Production - Foodgrain Crops. Volume I ICAR Publication.
5. S.R. Reddy. 2009. Agronomy of Field Crops. Kalyani Publishers, New Delhi.

Farm Machinery and Power	AE-401	2 (1+1)
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Course Outcomes:

1. Familiar with Farm power & sources of farm power in India.
2. Getting knowledge about Two Stroke and Four Stroke Engines, Working Principles, Applications- Types, Power and Efficiency
3. Getting Familiar with different systems of I.C. engines
4. Familiar with Power transmission systems
5. Familiar with Primary & Secondary tillage implements concerning with farm Machinery and plant protection equipment.

Theory

UNIT I: Status of Farm Power in India; Sources of Farm Power, I.C. engines, working principles of I C engines; comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine, I.C. engine terminology and solved problems.

UNIT II: Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor.

UNIT III: Familiarization with Power transmission system : clutch; gear box, differential and final drive of a tractor; Tractor types; Cost analysis of tractor power and attached implement; Criteria for selection of tractor and machine implements.

UNIT IV: Familiarization with Primary and Secondary Tillage implement; Implement for hill agriculture; implement for intercultural operations.

UNIT V: Familiarization with sowing and planting equipment; calibration of a seed drill and solved examples; Familiarization with Plant Protection equipment; Familiarization with harvesting and threshing equipment.

Practical

Study of different components of I.C. engine. To study air cleaning and cooling system of engine; Familiarization with clutch, transmission, differential and final drive of a tractor; Familiarization with lubrication and fuel supply system of engine; Familiarization with brake, steering, hydraulic control system of engine; Learning of tractor driving; Familiarization with operation of power tiller; Implements for hill agriculture; Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough and disc harrow; Familiarization with seed-cum-fertilizer drills their seed metering mechanism and calibration, planters and trans planter; Familiarization with different types of sprayers and dusters; Familiarization with different inter-cultivation equipment; Familiarization with harvesting and threshing machinery; Calculation of power requirement for different implements.

Suggested readings

1. Jagdiswar Sahay – Elements of Agricultural Engineering
2. Jain, S.C. and C.R. Rai-Farm Tractor and maintenance and repair. Standard Publishers, 1705-B, Naisarak. Delhi- 110006 .
3. Ojha, T.P. and A.M. Michael, A.M. Principles of Agricultural Engineering. Vol.I. Jain brothers, 16/893, East Park Road, Karol Bagh, New Delhi -110005
4. Surendra Singh- Farm machinery –Principles and applications, ICAR, New Delhi

Water Management	AGRO-402	2 (1+1)
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Course Outcomes

1. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development
2. To study different methods of irrigation and water management practices of both field and horticultural crops and drainage.
3. To study the soil moisture conservation practices including management of rain water, watershed and command areas.

Theory

Unit I: Irrigation: definition and objectives; Importance: Function of water for plant growth, water resources and irrigation development for different crops in India.

Unit II: Soil plant water relationships; Available and unavailable soil moisture, distribution of soil moisture, water budgeting, rooting characteristics, moisture extraction pattern, effect of moisture stress on crop growth. Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, different approaches of scheduling of irrigation.

Unit III: Methods of irrigation: surface and sub-surface, pressurized methods, viz., sprinkler and drip irrigation, their suitability, merits and limitations, fertigation, economic use of irrigation water; Layout of different irrigation systems, Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management.

Unit IV: Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); quality of irrigation water, irrigation management practices for different soils and crops, drip, sprinkler.

Unit V: Layout of underground pipeline system, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.

Practical

Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers' field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; layout for different methods of irrigation, Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Visit to irrigation research centre/ station and visit to command area.

Suggested Readings

1. Rao, Y.P. and Bhaskar, S.R. Irrigation technology. Theory and practice. Agrotech publishing Academy, Udaipur.
2. Dilipkumar Mujmdar. Irrigation water management: Principles and Practices. Prentice Hall of India Pvt. Ltd.,
3. S.V. Patil & Rajakumar, G. R., Water Management in Agriculture and Horticultural Crops. Satish serial publishing House, Delhi.
4. Carr M. K. V. and Elias Fereres. Advances in Irrigation Agronomy. Cambridge University Press.
5. Michael, A.M. Irrigation Theory and practice. Vikas publishing house Pvt, Ltd.

Problematic Soils and their management	SOIL-401	2(1+1)
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Course outcome:

1. Demonstrate knowledge of various types of problematic soils, including expansive soils, saline-alkaline soils, peat soils, and erodible soils.
2. Recognize their properties, classification, and geographical distribution.

3. Conduct field and laboratory tests to identify problematic soil conditions.
4. Apply appropriate soil stabilization techniques, such as chemical, mechanical, and biological methods, to improve soil strength and usability.
5. Propose strategies for reclamation of saline-alkaline soils, including leaching, gypsum application, and drainage.

Theory

UNIT I: Soil quality and health, Distribution of Waste land and problem soils in India, Categorization of Problem soils based on properties.

UNIT II: Reclamation and management of Acid soils, Saline, Sodic soils, Acid Sulphate soils, Eroded and Compacted soils, polluted soils.

UNIT III: Contaminated soils (Pesticide contamination, Heavy metal contamination), Mined soils (Coal mined, Oil mined), Management of Riverine soils, Waterlogged soils, Irrigation water – quality and standards, utilization of saline water in agriculture.

UNIT IV: Use of Remote sensing and GIS in diagnosis and management of problem soils. Irrigation and water quality.

UNIT V: Multipurpose tree (MPT) species, bio remediation through MPTs of soils, land capability and classification, land suitability classification.

Practical

1. Determination of pHs and EC of saturation extract of problematic soil.
2. Determination of redox potential in soil.
3. Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil.
4. Determination of Gypsum requirement of alkali / sodic soil.
5. Determination of lime requirement of acidic soil.
6. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO₃, HCO₃, Cl, SAR and RSC).
7. Determination of nitrate (NO₃⁻) from irrigation water.
8. Determination of dissolved oxygen and free carbon dioxide levels in water samples.

Suggested readings

1. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, AGROBIOS (India).
2. Brady Nyle C and Ray R Well., 2014. Nature and properties of soils. Pearson Education Inc., New D Delhi.
3. Cirsan J. Paul., 1985,. Principles of Remote Sensing. Longman, New York
4. Indian Society of Soil Science., 2002. Fundamentals of Soil Science. IARI, New Delhi.

Basics of Plant Breeding	GPB-401	3(2+1)
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Course Outcomes

1. Familiar with basics of Fundamentals of Plant breeding
2. Familiar with different Plant Breeders kit.

3. Getting acquainted with Emasculation & hybridization techniques.
4. Study about the breeding methods for segregating generations in field.
5. Knowledge about Biotechnological tools.
6. Getting acquainted with farmers and breeders rights.

Theory

Unit I: Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self- incompatibility and male-sterility-genetic consequences, cultivar options, Plant genetic resources, its utilization and conservation Domestication, Acclimatization and Introduction. Centres of origin/ diversity

Unit II: Components of Genetic variation. Heritability and genetic advance. Pre-breeding and Universal Plant Breeder's equation. Genetic basis and breeding methods in self-pollinated crops- mass and pure line selection, hybridization techniques and handling of segregating population. Multiline concept, Concepts of population genetics and Hardy-Weinberg Law

Unit III: Genetic basis and methods of breeding cross-pollinated crops, modes of selection. Population movement schemes- Ear to Row method, Modified Ear to Row, recurrent selection schemes. Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties

Unit IV: Breeding methods in asexually propagated crops, clonal selection and hybridization. Wide hybridization and pre-breeding. Polyploidy in relation to plant breeding, mutation breeding- methods and uses

Unit V: Breeding for important biotic and abiotic stresses. Participatory plant breeding. Variety Release and notification. Intellectual Property Rights, Patenting, Plant Breeders and Farmer's Rights

Practical

Plant Breeder's kit, Study of germplasm of various crops, Study of floral structures of self-pollinated and cross-pollinated crops, Emasculation and hybridization techniques in self and cross pollinated crops, Consequences of inbreeding on genetic structure of resulting populations, Study of male sterility system, Handling of segregating populations, Methods of calculating mean, range, variance, standard deviation, heritability, Designs used in plant breeding experiments, analysis of Randomized Block Design, To work out the mode of pollination in a given crop and extent of natural out-crossing, Prediction of performance of double cross hybrids, Maintenance of breeding records and data collection, Screening tests for biotic and abiotic stresses.

Suggested Readings

1. Principles of Plant Breeding (1st & 2nd Edition) by RW Allard.
2. Plant Breeding: Principles & Practices by JR Sharma.
3. Plant Breeding- B.D. Singh.
4. Principles and Procedures of Plant Breeding - Biotechnical and Conventional Approaches by GS Chahal and SS Gosal.

FIFTH SEMESTER

S. No.	Subject Name	Subject Code	Credit Hours
1.	Agricultural Marketing and Trade	ECO-501	3 (2+1)
2.	Introduction to Agro-meteorology	AMT-501	2(1+1)
3.	Fundamentals of Crop Physiology	CPHY-501	3(2+1)
4.	Pest management in Crops and Stored Grains	ENT-501	3 (2+1)
5.	Diseases of Field & Horticultural Crops & their Management	PATH-501	3(2+1)
6.	Crop Improvement (kharif crops) - I	GPB-501	2 (1+1)
7.	Weed Management	AGRO-501	2(1+1)
8.	Ornamental Crops, MAPs and Landscaping	HORT-501	2 (1+1)
9.	Introductory Agro forestry	AGRO-502	2 (1+1)
10.	Educational Tour	ET-501	2(0+2)

Syllabus

Agricultural Marketing and Trade	ECO-501	3 (2+1)
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Course outcomes

1. To understand the fundamentals of agricultural marketing and trade
2. To analyze the factors influencing supply and demand in agricultural markets
3. To explore different marketing channels and strategies in agriculture
4. To examine the role of government policies and regulations in agricultural markets

Theory

Unit I: Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; Demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities;

Unit II: Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits; Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark);

Unit III: Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of

Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India;

Unit IV: Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage.

Unit V: Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR; Role of government in agricultural marketing; Role of APMC and its relevance in the present day context.

Practical

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning. Application of principles of comparative advantage of international trade.

Suggested Readings

1. Acharya, S.S. and Agarwal, N.L. 2006. Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Chinna, S.S. 2005. Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
3. Dominic Salvatore, Micro Economic Theory
5. Kohls Richard, L. and Uhl Josheph, N. 2002. Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
6. Kotler and Armstrong, 2005. Principles of Marketing, Pearson Prentice-Hall.

Introduction to Agro-meteorology	AMT-501	2(1+1)
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Course Outcomes:

1. To introduce the students to the concept of weather and climate and underlying physical processes occurring in relation to plant and atmosphere
2. To impart the theoretical and practical knowledge of instruments/equipment used for measurement of different weather variables in an agrometeorological observatory
3. To study the meteorological aspects of climate change in agriculture and allied activities

Theory

Unit I: Meaning and scope of agricultural meteorology; Earth atmosphere: its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar

constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo.

Unit II: Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Application of Thermal time concept and Crop/Pest weather calendar; Energy balance of earth; Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud.

Unit III: Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon-mechanism and importance in Indian agriculture.

Unit IV: Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations; Modifications of crop microclimate, climatic normal for crop and livestock production.

Unit V: Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture.

Practical

Visit of Agro-meteorological Observatory, site selection of observatory, exposure of instruments and weather data recording, Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law, Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS; Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis, Measurement of soil temperature and computation of soil heat flux, Determination of vapor pressure and relative humidity, Determination of dew point temperature, Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparation of windrose, Measurement, tabulation and analysis of rain, Measurement of open pan evaporation and evapotranspiration, Computation of PET and AET, Use of synoptic charts, weather reports, weather forecasting-types and methods, crop weather calendar.

Suggested Readings

1. Agricultural Meteorology by G.S.L.H.V. Prasado Rao
2. Fundamentals of Agrometeorology and Climate Change by G. S. Mahi and P. K. Kingra
3. Introduction to Agrometeorology and Climate Change by Alok Kumar Patra
4. Introduction to Agrometeorology by H. S. Mavi
5. Text Book of Agricultural Meteorology by M. C.Varshneya and P.B. Pillai

Fundamentals of Crop Physiology	CPHY-501	3(2+1)
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Course Outcome

1. Define different physiological process at plant and cellular level
2. Summarize mechanisms of uptake, transport and translocation of water and nutrients

3. Distinguish carbon cycles in plants and define lipid metabolism
4. Relate the importance of growth regulators in plant growth
5. Explain nutrient deficiencies and physiological requirements of plants
6. Interpret and measure plant physiological data

Theory

Unit I: Definitions of plant physiology and crop physiology; Importance of crop physiology; Relationship of crop physiology with other branches of crop science; Diffusion and osmosis; Physiological roles of water to crop plants; Definition of water potential and components of water potential; Water absorption by plants: Concept of active and passive absorption; Water loss by plants: Types of water loss: transpiration, stomatal physiology and guttation;

Unit II: Water use efficiency; Essential and beneficial elements; Passive and active transport of mineral element; Functions of essential elements; Criteria of essentiality of nutrients; Correction measures for nutrient deficiency symptoms; Foliar nutrition and root feeding – significance; Aeroponics Imbibition; Field capacity, permanent wilting point and available soil moisture; Apoplast, symplast and transmembrane, Ascent of sap – theories and mechanism;

Unit III: Soil-plant-atmospheric continuum. Significance of transpiration. Stomatal opening and closing mechanisms. Definition of Cavitation and embolism. Antitranspirants - types and examples. Hydroponics and sand culture. Overview of plant cell - organelle and their functions. Brief outline of: Photosynthetic apparatus, pigment system, quantum requirement and quantum yield; Structure of chloroplast, Examples of different photosynthetic pigments (chlorophyll, carotenoids, phycobilins etc.), Difference between chlorophyll a and chlorophyll b, Structure of chlorophyll a and chlorophyll b, Short discussion on quantum requirement and quantum yield, Red drop and Emerson enhancement effect, Pigment system I and II.

Unit IV: Introduction to light reaction of photosynthesis, Light absorption by photosynthetic pigments and transfer of energy. Source of O₂ during photosynthesis: Hill reaction; Brief introduction to cyclic and non-cyclic photo-phosphorylation: production of assimilatory powers; Introduction to C₃, C₄ and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle; Significance of these pathways (concept of photorespiration, absence of photorespiration in C₄ plant: Productivity of C₄ plant, CAM: an adaptive mechanism); Factors affecting photosynthesis (light, temperature, CO₂, O₂ etc.). Outline of the process of respiration: Definition and importance, Glycolysis, Krebs Cycle and ETC, Factors affecting respiration (O₂, temperature, CO₂ etc.).

Unit V: Terminologies / Definitions: Growth, Development and Differentiation. Measurement of plant growth (fresh weight, dry weight, linear dimension, area etc.). Introduction to CGR, RGR, NAR etc. Photoperiodism: Photoperiodic Classification of plants: Short Day Plant, Long Day Plant, Day Neutral plant etc. Introduction to Photoperiodic induction site of photo-inductive perception, Role of Phytochrome Introduction to Vernalization (What is vernalization, de vernalization etc.), Meaning, classification (seasonal, sequential etc), relation with abscission. Physiological and biochemical changes during senescence, Abscission and its significance, Concept of stay green, Hormonal regulation of senescence. Terminologies / Definitions: Plant hormone, Plant growth regulators (PGR),

Plant growth inhibitor. Recognized classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene and Absciscic acid) and their major physiological roles, Agricultural uses of PGRs (IBA, NAA, 2, 4 –D, GAs, Kinetin etc).

Practical

Study on structure and distribution of stomata; Demonstration of imbibition, osmosis, plasmolysis, estimation of water potential, relative water content; Tissue test for mineral nutrients, identification of nutrient deficiency and toxicity symptoms in plant; Identification of nutrients by hydroponics; Estimation of photosynthetic pigments, rate of photosynthesis, respiration and transpiration; Plant growth analysis; Study on senescence and abscission, hormonal regulation of senescence; Demonstration of the effects of different PGRs on plants, Leaf anatomy of C3 and C4 plants.

Suggested readings

1. Devlin's Exercises in Plant Physiology by Robert Devlin, Francis H. Witham and David F. Blaydes
2. Fundamentals of Plant Physiology by Lincoln Taiz, Eduardo Zeiger, Ian Max Mølle and Angus Murphy
3. Plant Physiology by Robert M. Devlin and Francis H. Witham
4. Plant Physiology by Lincoln Taiz and Eduardo Zeiger
5. Plant physiology by Frank B. Salisbury and Cleon W. Ross

Pest management in Crops and Stored Grains	ENT-501	3 (2+1)
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Course Outcomes:

1. Diagnosis and management of major insect and non- insect pests of crops in field and storage.

Theory

UNIT-I: General description on nature and type of damage by different arthropod pests; Scientific name, order, family, host range, distribution, biology and bionomics; Nature of damage and management of major insect pests of various field crops, vegetable crops, fruit crops, plantation crops, ornamental crops, spices and condiments.

UNIT-II: Structural entomology and important household pests, their nature of damage and management. Factors affecting loss of stored grains. Insect pests, mites, rodents, birds and microorganisms associated with stored grains and their management

UNIT-III: Storage structures and methods of grain storage and fundamental principles of stored grains management. Management of non-insect pest of mites, snails and slugs,

UNIT-IV: Concept of IPM, Practices, scope and limitations of IPM.

UNIT-V: Classification of insecticides, toxicity of insecticides and formulations of insecticides, Biorational pesticides including insect repellents, antifeedants, Use of drones and AI in pest management.

Practical

Field visit, identification of major insect pests and their damage symptoms. Collection and preservation of major insect pests; collection of damage samples, their identification and herbarium preparation. Methods of monitoring of pest incidence in situ. Management strategies of insect pests of different crops. Study on structural entomology and household pests. Storage structures and methods of grain storage. Spraying techniques for selected field and horticultural crops. Vertebrate pest management, Mass multiplication of NPV and entomopathogenic nematodes.

Suggested readings

1. A Textbook of Insect Pest and Disease Management, 2021. Somnath Sen, and Mohd. Sameer, S. Kataria & Sons publish.
2. Agricultural Pests of India and South east Asia, A.S. Athwal, Kalyani Publishers.
3. A Textbook of Applied Entomology, K.P. Srivastava and G. S. Dhaliwal, Kalyani Publish.
4. Essentials of Pest Management: Key Information on Pest Identification and its Management, 2022. Prakash Rambhat Thalya and Ravi Chandra
5. Integrated pest Management Concept and Approaches- G.S. Dhaliwal and Ramesh Arora
6. Pest Management: Methods, Applications and Challenges, Tarique Hassan Askary, Agriculture, Agriculture Issues and policies, Books, Nova, Pest Control, Science and Technology, 2022

Diseases of Field & Horticultural Crops & their Management	PATH-501	3(2+1)
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Objectives

1. To study the symptoms produced on the host.
2. To study the etiology of the diseases.
3. To know about the disease cycle of the pathogens during pathogenesis
4. To study the epidemiological factors responsible for disease development
5. To study the management techniques for curbing the major diseases of field and horticultural crops

Theory

Symptoms, etiology, disease cycle, epidemiology and management of major diseases of the following field and horticultural crops:

Field crops-

Unit-I: Rice (blast, brown spot, sheath blight, false smut, bacterial leaf blight, bacterial leaf streak, tungro, khaira); Wheat (rusts, loose smut, Karnal bunt); Maize (banded leaf and sheath blight, southern and northern blight, downy mildew); Sorghum (smuts, grain mold, anthracnose); Bajra (downy mildew, ergot) and Finger millet (blast, leaf spot).

Unit-II: Groundnut (early and late leaf spots, rust, wilt); Soybean (rhizoctonia blight, bacterial spot, seed and seedling rot, mosaic); Grams (Ascochyta blight, wilt, grey mold); Pea (downy mildew, powdery mildew, rust); Black gram and Green gram (web blight, Cercospora leaf spot, anthracnose, yellow mosaic); Sugarcane (red rot, smut, grassy shoot, ratoon stunting, PokahBoeng); Mustard (Alternaria blight, white rust, downy mildew, sclerotinia stem rot) and Sunflower (sclerotinia stem rot, Alternaria blight); Cotton (anthracnose, vascular wilts, black arm).

Horticultural crops:

Unit-III: Citrus (canker, gummosis) and Guava (wilt, anthracnose); Banana (sigatoka, Panama wilt, bacterial wilt, bunchy top); Papaya (foot rot, leaf curl, mosaic) and Pomegranate (bacterial blight); Apple (scab, powdery mildew, fire blight, crown gall) and Peach (leaf curl); Grapevine (downy mildew, powdery mildew, anthracnose) and Strawberry (leaf spot).

Unit-IV: Coconut (bud rot, Ganoderma wilt), Tea (blister blight) and Coffee (rust); Mango (anthracnose, malformation, bacterial blight, powdery mildew); Potato (early and late blight, black scurf, leaf roll, mosaic) and Tomato (damping off, wilt, early and late blight, leaf curl, mosaic); Brinjal (phomopsis blight and fruit rot, sclerotinia blight) and Chilli (anthracnose and fruit rot, wilt, leaf curl).

Unit-V: Cucurbits (powdery and downy mildew, wilts) and Cruciferous vegetables (Alternaria leaf spot, black rot, cauliflower mosaic); Beans (anthracnose, bacterial blight) and Okra (yellow vein mosaic); Ginger (soft rot), Turmeric (leaf Spot) and Coriander (stem gall); Rose (dieback, powdery mildew, black leaf spot) and Marigold (botrytis blight, leaf spots).

Practical

To study the symptoms of different diseases of field and horticultural crops: Blast and brown spot of rice, sheath blight and bacterial leaf blight of rice, downy mildew and powdery of cucurbits, rhizoctonia and Cercospora leaf spot of green gram / black gram, Alternaria blight and downy mildew of mustard, early blight of late blight of potato and tomato, Phomopsis blight of brinjal, powdery mildew and rust of pea, stem gall of coriander, anthracnose and fruit rot of chilli, taphrina leaf spot of turmeric, red rot of sugarcane, acquaintance with fungicides, antibiotics and biopesticides and their use in management of diseases of horticultural crops. Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems, Collection and preservation of plant diseased specimens for herbarium.

Suggested readings

1. Integrated Plant Disease Management by R.C. Sharma
2. Plant Diseases by R.S. Singh
3. Plant Disease Management: Principles and Practices by Hriday Chaube
4. Plant Pathology by G.N. Agrios

Crop Improvement (kharif crops) - I	GPB-501	2 (1+1)
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Course Outcome

1. To provide knowledge about Self-pollinated and cross pollinated Kharif crops
2. To learn about origin and distribution of Kharif crops
3. To design breeding objectives of major kharif crops
4. To impart information on different crop varieties for Kharif season

Theory

Unit I: Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops of kharif season

Unit II: Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters

Unit III: Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)

Unit IV: Hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeonpea etc.

Unit V: Ideotype concept, climate resilient crop varieties for future

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. rice, jute, maize, sorghum, pearl millet, ragi, pigeonpea, urdbean, mungbean, soybean, groundnut, sesame, castor, cotton, cowpea, tobacco, brinjal, okra and cucurbitaceous crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seed production in kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

Suggested Readings

1. Breeding field crops -I by V.L. Chopra
2. Genetic improvement of field crops by C.B. Singh and D. Khare
3. Genetics and Breeding of Pulse crops by D.P. Singh
4. Vegetable breeding – Principles and Practices by Hari Har Ram
5. Breeding field crops by D.A. Sleper and J.M. Poehlman
6. Plant Breeding –theory and practice by S.K. Gupta

Weed Management	AGRO-501	2(1+1)
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Course Outcomes:

1. To teach students about principles of weed science
2. To impart practical knowledge of weed management in field and horticultural crops

Theory

Unit I: Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem.

Unit II: Classification, reproduction and dissemination of weeds, crop-weed competition, factors of competition, factors affecting growth and development.

Unit III: Studies on weed seed bank, weed shifts. Concepts of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management.

Unit IV: Implements for weed control, robotic weed control, weed management in organic/natural farming. Herbicide classification and properties of important herbicides, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides, precision weed management; Mode of action of herbicides and selectivity phenomenon.

Unit V: Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with agro-chemicals and their application, Herbicide resistance and its management. Weed management in different field and horticultural crops; aquatic weed management, weed management in cropping systems.

Practical

Techniques of weed preservation, weed identification and losses caused by weeds. Biology of important weeds. Study weeds in different situations, Study of herbicide formulations and mixture of herbicide. Study methods of herbicide application, Herbicide application equipment- their parts, use, maintenance and calibration. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index, Phytotoxicity of herbicides, Weed management in fallow lands, Management of problem and parasitic weeds.

Suggested Readings

1. Crafts, A.S. and Robbins, W.W. 1973. Weed Control. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. Gupta, O.P. 1984. Scientific Weed Management. Today and Tomorrow Printers and Publishers, New Delhi.
3. Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.
4. Naidu, V.S.G.R. Handbook of Weed Identification. Directorate of Weed Research, Jabalpur.
5. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G. 2015. Weed management of Horticultural Crops. Agrobios (India), Jodhpur.

Ornamental Crops, MAPs and Landscaping	HORT-501	2 (1+1)
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Course Outcomes:

1. To educate in detail about origin, area, climate, soil, improved varieties production technology of flowers and MAPs
2. To educate about concept, designing principles and components of landscaping
3. To educate about the physiological disorders of commercial flowers
4. To educate about the post-harvest management and value addition in flower crops and MAP

Theory

Unit I: Production technology of ashwagandha, costus, isabgol and geranium; Production technology of mint, aloe and ocimum, Coleus, Glory lily, Periwinkle etc.

Unit II: Production technology of plants like lemongrass, citronella, vetiver and palmarosa etc., Importance and scope of ornamental crops; Importance and scope of medicinal and aromatic plants and landscaping;

Unit III: Principles of landscaping; Landscape uses of trees, shrubs and climbers, Production technology of important cut flowers like rose, gerbera and orchids; Production technology of gladiolus, tuberose and liliun; Production technology of chrysanthemum and carnation;

Unit IV: Package of practices for loose flowers like marigold and jasmine under open conditions; Brief concept of Home landscaping, Carpet bedding, Topiary, Bonsai, Lawn, flower arrangement, Herbaceous Border, Hedge, Edge etc.

Unit V: Processing and value addition imp ornamental crops; Processing and value addition of MAPs produce.

Practical

Identification MAPs and Ornamental plants (trees, shrubs, climbers, seasonal flower and house plants). Propagation of MAP, Bed preparation and planting of MAP; Nursery bed preparation and sowing of seasonal flower seeds; Propagation of ornamental plants by terminal/herbaceous cuttings; Propagation of Anthurium and orchids; Propagation of bougainvillea; Planting of gerbera suckers; Gladiolus corms; Establishment and maintenance of lawn; Preparation of flower preservatives and their use in extending the vase life of cut flowers; Training and pruning of ornamental plants and raising of hedge and edge; Planning and layout of garden.

Suggested readings

1. Floriculture in India by G.S. Randhawa and Mukopadhyay
2. Introduction to spices, plantation crops, medicinal and aromatic plants by N. Kumar, Abdul Khadder, P. Rangaswamy, I. Irulappam
3. Textbook of floriculture and landscaping by Anil K. Singh and Anjana Sisodia
4. Commercial flowers (Vol 1 and 2) by T.K. Bose.

Introductory Agro forestry	AGRO-502	2 (1+1)
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Course Outcomes:

1. To study Agro forestry as an alternate system of land use
2. To study different types of Agro forestry for soil and water conservation.
3. To study the characteristics of Agro forestry in terms its potential for soil moisture conservation practices

Theory

Unit I: Agro-forestry: Definition and scope of Agroforestry system, Type of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in India.

Unit II: MPTS- definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of India, Ecological aspects of Agroforestry system, tree -crop interaction – competition, nutrient recycling; Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India.

Unit III: Management of Agro-forestry system; Role of agroforestry in soil and water conservation; windbreak; Shelterbelt– definition, objectives.; Socio- economic aspects of Agroforestry system; Design and Diagnostic study of agroforetry system.

Unit IV: Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root and seedling, field handling of nursery stock.

Unit V: Management of tree species; Silviculture of important tree species, choice of species-site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc. Horticulture and forage crops-based agroforestry models developed by ICAR-IGFRI; Agroforestry models developed by Indian council of Forestry Research and Education.

Practical

Identification of tree species in agro-forestry, Study of tree growth measurement, Study of environmental parameters affecting AF System, Plant propagation methods, Pre-sowing seed treatment, Preparation of nursery bed exercise, practicing propagation techniques for trees, Afforestation method, practical training, pruning, coppicing, pollarding etc. Planting pattern and designs for plantation, natural and artificial regeneration, Design and diagnostic survey of agro- forestry system, Evaluation of agro-forestry system in different agro climatic zones, Exposure Visit to prevailing agroforestry systems of the state and related important institutions, Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE.

Suggested readings

- 1- Nair, P.K. R. 1993. An Introduction to Agroforestry, Kluar Academic Publisher
- 2- Chundawat D. S. and S.K. Gautham. 2017. Textbook of Agroforestry. Oxford & IBH Publishing, (ISBN: 9788120408326)
- 3- Parthiban, K. T, N. Krishnakumar and M. Karthick. 2018. Introduction to Forestry, Scientific Publisher, Jodhpur. 350p
- 4- Divya M. P. and K. T. Parthiban. 2005. A Textbook on Social Forestry and Agroforestry. Satish Serial Publishing, New Delhi (ISBN: 9384988952).

SIXTH SEMESTER

S. No.	Subject Name	Subject Code	Credit Hours
1.	Fundamentals of Agri Biotechnology	ABOT-601	3(2+1)
2.	Basic and Applied Agril Statistics	STAT-601	3(2+1)
3.	Crop Improvement (Rabi crops) - II	GPB-601	2(1+1)
4.	Renewable energy in Agriculture and Allied Sector	AE-601	2(1+1)
5.	Dryland agriculture/ Rainfed agriculture and watershed management	AGRO-601	2(1+1)
6.	Agricultural Microbiology and Phyto - remediation	PATH-601	2(1+1)
7.	Agricultural Finance & Cooperation	ECO-601	2(1+1)
8.	Essentials of Plant Biochemistry	BCH-601	3 (2+1)
9.	Fundamentals of Seed Science & Technology	GPB-602	2(1+1)
10.	Online Course		3

Detailed Syllabus

Fundamentals of Agri Biotechnology	ABOT-601	3(2+1)
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Course outcome:

1. Learn and gain knowledge about Concept of application of diversified biotechnological applications in the field of Agriculture.
2. Comprehend the systems, components, types, process of operation demands of the Agriculture Biotechnology Industry.
3. Learn to apply technical knowledge and skills required for understanding and application of the Agriculture Biotechnology.
4. Learns to analyse the governing principles and sciences of Agriculture Biotechnology.
5. Synthesize required techno managerial process solution and application required in Agriculture Biotechnology.

Theory

Unit I: Introduction to Plant Tissue Culture and Genetic Engineering: History; Cellular totipotency and cytodifferentiation; Callus culture, Single-cell/suspension culture and their applications; Organogenesis and somatic embryogenesis; Somaclonal variation and its use in crop improvement.

Unit II: Embryo rescue technique and its significance in hybrid development; In vitro fertilization, ovule culture and its significance in hybrid development; Protoplast isolation, culture and regeneration; Somatic hybridization (somatic hybrids and cybrids) and its application in crop improvement; Anther and pollen culture for haploid production.

Unit III: Development of disease-free (virus free) plants through apical meristem culture; Micropropagation technique for the generation of quality planting material; Synthetic seeds and its applications; National certification and Quality management of TC plants-secondary metabolite production- in vitro germplasm conservation.

Unit IV: Introduction to Molecular Biology: DNA structure, structure and function; DNA replication, transcription and translation, RNA, types and function; Structure of prokaryotic and eukaryotic gene; Central dogma of life - DNA replication, transcription, genetic codes-translation and protein synthesis; Lac Operon concept - Nucleic acid hybridization; Polymerase chain reaction- DNA sequencing – Sanger method; PCR and its applications.

Unit V: Introduction to recombinant DNA technology: DNA modifying enzymes and vectors; plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-mediated gene transfer methods; Transgenic and its importance in crop improvement with successful stories; biosafety. Introduction to various molecular markers: RFLP, RAPD, SSR, SNP etc.; Marker-assisted breeding in crop improvement.

Practical

1. Introduction to Plant Tissue Culture Laboratory
2. Good Laboratory Practices; Media Preparation and sterilization; Glassware sterilization

3. Micropropagation; Callus induction and culture; Anther culture; Apical meristem culture; Preparation of synthetic seeds.
4. Isolation of plasmid DNA; Quantification of DNA.
5. Agarose Gel Electrophoresis and visualization of plasmid DNA.
6. Restriction digestion of plasmid DNA and agarose gel electrophoresis.
7. Isolation of Plant genomic DNA; PCR amplification of DNA.
8. Gel electrophoresis of amplified DNA;
9. Visit to tissue culture units/biotech labs.
10. Different sterilization Techniques.

Suggested readings

1. Bhojwani SS. 1983. Plant Tissue Culture: Theory and Practice. Elsevier.
2. Singh BD. 2007. Biotechnology: Expanding Horizon. Kalyani
3. Christou P and Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.
4. Lewin B. 2008. Gene IX. Peterson Publications/ Panima. W.H. Freeman & Co.
5. Primrose SB. 2001. Molecular Biotechnology. Panima.

Basic and Applied Agril Statistics	STAT-601	3(2+1)
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Course Outcomes:

1. To provide an idea on statistical concepts of both descriptive and inference Statistics which will be useful to do statistical analysis

Theory

Unit I: Introduction to Statistics and its Applications in Agriculture. Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the no. of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram. Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives.

Unit II: Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean– Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. Median- Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode- Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.

Unit III: Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation- Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation. Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of

Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.

Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability-Definition and Limitations. Empirical Probability-Definition and Limitations. Axiomatic Probability.

Unit IV: Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution- Definition, Prob. Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve. Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients. Tests of Significance. Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples. F-test for Variance.

Unit V: ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.

Practical

Diagrammatic and Graphical representation of data. Calculation of A.M., Median and Mode (Ungrouped and Grouped data). Calculation of S.D. and C.V. (Ungrouped and Grouped data). Correlation and Regression analysis. Application of t-test (one sample, two sample independent and dependent). Analysis of variance one-way classification. CRD. Selection of random sample using simple random sampling.

Suggested readings

1. Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers.
2. Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons.
3. Basic Statistics by B. L. Agarwal, New Age International Publishers.
4. Agricultural Statistics by S.P. Singh and R.P.S. Verma, Rama Publishing House.
5. Agriculture and Applied Statistics-I by P.K. Sahu, Kalyani Publishers.
6. Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers.

Crop Improvement (Rabi crops) - II	GPB-601	2(1+1)
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Course Outcome

1. To provide knowledge about self-pollinated and cross-pollinated rabi crops
2. To learn about origin and distribution of rabi crops
3. To design breeding objectives of major rabi crops
4. To impart information on different crop varieties for rabi season

Theory

Unit I: Centres of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibres; fodders and cash crops; vegetable and other horticultural crops

Unit II: Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters

Unit III: Important concepts of breeding self-pollinated, cross-pollinated and vegetatively propagated crops. Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional)

Unit IV: Hybrid seed production technology in wheat, oat, chickpea, rapeseed and mustard etc.

Unit V: Ideotype concept, climate resilient crop varieties for future

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. wheat, oat, rapeseed and mustard, pulses, potato, sugarcane, tomato, chilli, onion etc. Study of field techniques for seed production and hybrid seed production in rabi crops; Estimation of heterosis, inbreeding depression and heritability; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops

Suggested readings

1. Breeding Field Crops -I by V.L. Chopra
2. Genetic Improvement of Field Crops by C.B. Singh and D. Khare
3. Genetics and Breeding of Pulse crops by D.P. Singh
4. Vegetable Breeding – Principles and Practices by Hari Har Ram
5. Breeding Field Crops by D.A. Sleper and J.M. Poehlman

Renewable energy in Agriculture and Allied Sector	AE-601	2(1+1)
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Course outcome

1. Understand the various forms of conventional energy resources.
2. Explain the concept of various forms of renewable energy
3. Identification of solar cooker, solar water heater, solar drying, solar pond, solar pump, solar light, solar distillation etc.
4. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.
5. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications

Theory

UNIT I: Classification of energy sources, contribution of these of sources in agricultural sector; Familiarization with biomass utilization for biofuel production and their application.

UNIT II: Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and bio-oil production and their utilization as bioenergy resource.

UNIT III: Introduction of solar energy, collection and their application; Familiarization with solar energy gadgets: solar cooker, solar water heater.

UNIT IV: Application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application.

UNIT V: Introduction of wind energy and their application. Availability of bio mass and their application in different places.

Practical

Familiarization with renewable energy gadgets. To study biogas plants, gasifier, production process of biodiesel, briquetting machine, production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping, solar fencing, solar cooker and solar drying system. To study solar distillation, solar pond and solar wind hybrid system. Field visit to Solar –Wind farm.

Suggested readings

1. C.S. Solanki. 2011. Solar Photovoltaic – Fundamentals, Technologies and Applications. PHI Learning Pvt. Ltd.
2. S. Sukhatme and J. Nayak. 2008. Solar Energy: Principles of Thermal Collection and Storage. Third Edition (Tata McGraw-Hill).
3. V.V.N. Kishore. 2008. Renewable Energy Engineering and Technology: Principles and Practice, Teri, India.

Dryland agriculture/ Rainfed agriculture and watershed management	AGRO-601	2(1+1)
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Course Outcomes:

1. To learn about characteristics and conditions of dryland/ rainfed agriculture
2. To gain knowledge about drought and its mitigation
3. To impart knowledge on water harvesting and watershed management

Theory

Unit I: Dryland/ Rainfed agriculture: Introduction, types and characteristics; History of dry land/ rainfed agriculture in India; Problems and prospects of dry land/rainfed agriculture in India.

Unit II: Soil and climatic conditions prevalent in dry land/rainfed areas; Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system; Soil and water conservation techniques.

Unit III: Drought: types, effect of water deficit on physio- morphological characteristics of the plants; Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices.

Unit IV: Crops and cropping systems in dry land/rainfed areas; Management of crops in dry land/rainfed areas; Contingent crop planning for aberrant weather conditions; Concept,

history, objective, principles and components of watershed management, factors affecting watershed management.

Unit V: Log term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Alternate land use system location; regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA) Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country. Effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure. Soil moisture determination under different land situations, Importance of seed priming to mitigate drought. Assessment of meteorological drought. Characterization and delineation of model watershed. Seed treatment, viz., seed hardening and seed priming techniques for all the agricultural crops Field demonstration on soil and moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Suggested readings

1. A.K. Srivastava and P.K. Tyagi. 2011. Practical Agricultural Meteorology. New Delhi Publishing Agency, New Delhi.
2. D. Lenka. 2006. Climate, Weather and Crops in India. Kalyani Publishers, New Delhi.
3. G.S.L.H.V. Prasad Rao. 2008. Agricultural Meteorology. Prentice Hall of India Pvt. Ltd., New Delhi.
4. H.S. Mavi and Graeme J. Tupper. 2005. Agrometeorology – Principles and applications of climate studies in agriculture. International Book Publishing Co., Lucknow.
5. H.S. Mavi. 1994. Introduction to Agrometeorology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Agricultural Microbiology and Phyto -remediation	PATH-601	2(1+1)
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Course Outcome:

1. Learn and gain knowledge about microorganism (prokaryotic cell) found in everywhere and their history of origin, useful and harmful role of microbes.
2. Comprehend the Knowledge about Understanding of Genetic recombination in bacteria and this process helpful for genetic engineering.
3. Learn to apply technical knowledge and skills required for understanding and application of the Soil Microbiology, Air Microbiology, Food Microbiology, and Water Microbiology:
4. Learn and gain knowledge about Industrial Microbiology and Biological control: Microbial biopesticides for plant disease management.
5. Learn to apply technical knowledge and skills required for understanding Concepts of rhizosphere microbiology; Rhizosphere microbiome- residents and their roles.

6. Comprehend the Knowledge about Understanding of Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability and Bioremediation; Phytoremediation of polluted soils.

Theory

Unit-I: Introduction to Microbiology: Definition, applied areas of Microbiology and Importance of Microbiology. History of Microbiology: Discovery of microorganisms, spontaneous generation theory, Germ theory of diseases, Immunization, fermentation, and origin of life.

Unit-II: Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, genetic engineering,

Unit-III: Soil Microbiology: Nutrient mineralization and transformation, Air Microbiology: Phyllosphere microflora, Phylloplane microflora, microflora of floral parts etc. Food Microbiology: Microbial spoilage and principles of food preservations, Food poisoning.

Unit-IV: Water Microbiology: Types of water, water microorganisms, and microbial analysis of water e.g. coliform test, Purification of water. Industrial Microbiology: Microbial products, Biodegradation, Biogas production, Biodegradable plastics etc. Biological control: Microbial biopesticides for plant disease management.

Unit-V: Concepts of rhizosphere microbiology- Rhizodeposits -biochemical nature, release mechanism in rhizosphere, function, Carbon flow in rhizosphere, Rhizosphere microbiome-residents and their roles. Potential of plant growth promoting rhizobacteria (PGPR) and endophytes on soil health and sustainability. Bioremediation of polluted soils using microbial mediators. Phytoremediation of polluted soils.

Practical

1. To study of the microscope;
2. To study of acquaintance with laboratory material and equipment;
3. To study of Microscopic observation of different groups of microorganisms: moulds (Fungi);
4. To study of Direct staining of bacteria by crystal violet;
5. To study of Negative or indirect staining of bacteria by nigrosin;
6. To study of Gram staining of bacteria;
7. To study of Study of phyllosphere and rhizosphere microflora;
8. To study of Measurement of microorganisms;
9. To study of Preparation of culture media;
10. To study of Isolation and purification of rhizospheric microbes;
11. To study of Isolation and purification of N-fixers;
12. To study of Isolation and purification of Nutrient solubilizers;
13. To study of Isolation and purification of Endophytes.

Suggested readings

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2002. Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.

2. Rangaswami, G. and Bagyaraj, D. J. 2005. Agricultural Microbiology. Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Mukherjee, N. and Ghosh, T. 2004. Agricultural Microbiology. Kalyani Publishers, Calcutta
4. Dubey, H.C. 2007. A Textbook of Fungi, Bacteria and Viruses. Vikas Publishing House Ltd., New Delhi – 10014
5. Salyers, A. A. and Whitt, D. D. 2001. Microbiology: diversity, disease, and the environment. Fitzgerald Science Press, Inc.

Agricultural Finance & Cooperation	ECO-601	2(1+1)
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Course outcomes

1. To impart knowledge on issues related to lending to priority sector credit management and financial risk management.
2. Learning the principles of finance, banking and co-operation, and farm financial analyses.
3. Understanding the functions of various institutions involved in farm financing and different crop insurance products implemented in India

Theory

Unit I: Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4 R's, and 3C's of credits.

Unit II: Sources of agricultural finance: institutional and non- institutional sources, commercial banks, social control and nationalization of commercial banks. Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India.

Unit III: Cost of credit. Recent development in agricultural credit. Preparation and analysis of financial statements – Balance Sheet and Income Statement. Basic guidelines for preparation of project reports. Bank norms – SWOT analysis.

Unit IV: Agricultural Cooperation – Meaning, brief history of cooperative development in India, objectives, principles of cooperation, significance of cooperatives in Indian agriculture. Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED. 3 R's, 5 C's and 7 P's of credit.

Unit V: Crop insurance: its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance Scheme). Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

Practical

Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial

bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business – A case study. Preparation and analysis of balance sheet – A case study. Preparation and analysis of income statement – A case study. Appraisal of a loan proposal – A case study. Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value-added products. Seminar on selected topics. Different types of repayment plans.

Suggested readings

1. Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins Univ. Press.
2. Reddy, S. S. and Ram, P.R. 1996. Agricultural Finance and Management. Oxford & IBH

Essentials of Plant Biochemistry	BCH-601	3 (2+1)
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Course Outcome:

1. Gain fundamental knowledge in biochemistry and understand molecular basis of various plant processes.
2. Learn and gain knowledge about biological Macromolecules & and their function
3. Comprehend the Knowledge about Understanding of metabolic pathways (catabolism as well as anabolism), their diversity and how these are specifically regulated and interrelated in different cells.
4. Learn to apply technical knowledge and skills required for understanding and application of the principles of Biochemistry in Agriculture Biotechnology.
5. Learns the Concepts of enzyme kinetics, regulation and specificity.
6. Develop a comprehensive understanding about structure, types, properties, role and mechanism of action of Carbohydrate, Protein, Lipid, Nucleic Acid

Theory

Unit I: Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components. Bio-molecules – Structure, classification, properties and function of carbohydrates, amino acids, proteins, lipids and nucleic acids. Vitamins – physiological and metabolic role.

Unit II: Enzymes: General properties; Classification; Mechanism of action; Michaelis and Menten and Line Weaver Burk equation and plots; Introduction to allosteric enzymes, use of enzymes.

Unit III: Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation.

Unit IV: Biosynthetic Pathways – Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation.

Unit V: Regulation of metabolic pathways. Secondary metabolites, Terpenoids, Alkaloids, Phenolic and their applications in food and pharmaceutical industries.

Practical

1. Preparation of standard solutions and reagents,
2. Determination of pH,
3. Qualitative tests of carbohydrates
4. Qualitative tests of amino acids,
5. Quantitative estimation of soluble sugars and starch,
6. Estimation of protein by Kjeldhal method
7. Estimation of protein by Lowry's method,
8. Preparation of mineral solution from ash, Estimation of fat by Soxhlet method,
9. Determination of acid value, saponification value and iodine number,
10. Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites.

Suggested Reading

1. Conn, Stumpf, Bruening and Doi. 2006. Outlines of Biochemistry. Fifth Edition. Wiley
2. Horton, Moran, Rawn, Scrimgeour, Perry. 2011. Principles of Biochemistry. Fifth Edition. Pearson/Prentice Hall (Can be downloaded)
3. Heldt. 2005. Plant Biochemistry.

Fundamentals of Seed Science & Technology	GPB-602	2(1+1)
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Course outcome

1. The students will gain knowledge about the various techniques of quality seed production, processing and seed quality enhancement
2. Develop an understanding of seed development, germination, vigor, deterioration and the relationship between laboratory tests and field performance.
3. Understand seed increase systems, seed testing and the laws and regulations related to marketing high quality seed.

Theory

Unit I: Introduction to seed technology, definition and importance

Unit II: Seed quality -definition, characters of good quality seed; Causes of deterioration of varietal purity and assessment of genetic purity

Unit III: Different classes of seed. Foundation and certified seed production of important cereals, pulses and oilseed, field inspection, importance and procedures

Unit IV: Post-harvest seed quality management; seed processing procedures, seed drying; Seed treatment, its importance, method of application and seed packing; seed storage - general principles, stages and factors affecting seed longevity during storage; Seed health management during storage. Seed Certification and legislation

Unit V: Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, basics of seed quality testing; New Seed Bill 2019; Seed quality enhancement techniques

Practical

Seed Structure, Seed sampling, Physical purity, Moisture determination, Germination test, Seed and seedling vigour test, Seed Viability, Genetic purity test: Grow out test, Field

inspection, Seed health testing using blotter and agar plate method. Visit to seed production farms, seed testing laboratories and seed processing plant.

Suggested Readings

1. Agarwal, R.L. 1995. Seed Technology (2nd edition). Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, India.
2. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India
3. Vanangamudi, K. 2014. Seed Technology (An illustrated book), New India Publishing Agency, New Delhi, India.

SEVENTH SEMESTER

S. No	Subject Name	Subject Code	Credit Hours
1.	Management of Natural Resources	AGRO-701	4(3+1)
2.	Agrochemical	SOIL-701	4(3+1)
3.	Protected Cultivation	HORT-701	4(3+1)
4.	Principles and Practices of Organic Farming and Conservation Agriculture	AGRO-702	4(3+1)
5.	Food Science and Nutrition	BCH-701	4(3+1)
6.	Online Course		3

Syllabus

Management of Natural Resources	AGRO-701	4(3+1)
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Course Outcomes:

1. To enlighten students about available natural resources and their relationship with crop production
2. To impart the knowledge of principles and practices of natural resource management

Theory

Unit I: Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.

Unit II: Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification. Landscape impact analysis, wetland ecology and management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management.

Unit III: Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system.

Unit IV: Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Introduction to soil and water conservation and causes of soil erosion., Definition and agents of soil erosion, water erosion - Forms of water erosion, Gully classification and control measures. Soil loss estimation by universal soil loss equation - Soil loss measurement techniques.

Unit V: Principles of erosion control - Introduction to contouring, strip cropping. Contour bund - Graded bund and bench terracing. Wind erosion - Mechanics of wind erosion, types of soil movement - Principles of wind erosion control and its control measures, Water harvesting techniques - Lining of ponds, tanks and canal systems.

Practical

Identifying natural resources and their utility. Practicing survey - Principles and educating to use pacing technique for measurement. Area calculations through chain survey - GPS demo for tracking and area measurement. Estimation of soil loss and calculation of erosion index. Leveling concepts and practical utility in agriculture. Preparation of contour maps. Concept of vegetative water ways and design of grassed water ways. Wind erosion and estimation process. Different irrigation pumps and their constructional differences. Farm pond construction and its design aspects. Visit to nearby farm pond. Visit to an erosion site. Exposure to strip cropping/contour bunding.

Suggested readings

1. Sustainable Natural Resource Management by Danill R. Lynch.
2. Management of Natural Resource for Sustainable Development, by Vijay Singh Rathor and B S Rathor, Daya Publishing House.
3. Managing Natural Resources: Focus on Land and Water. Ed. Harikesh N. Mishra. PHI, Learning, 496p.
4. Management of Resources for Sustainable Development: Sushma Goel. The Orient Blackswan 284p.
5. Natural Resources: Their Conservation and Management by Arvindrai Upadhyay. Aspiration Academy, 320p.
6. Natural Resource Management for Growth Development and Sustainability by Vasudeva Srishti Pal. Today & Tomorrows Printers and Publishers, 336p.

Agrochemical	SOIL-701	4(3+1)
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Course outcome:

1. Gain knowledge about various types of agrochemicals such as fertilizers, pesticides, herbicides, and plant growth regulators, including their composition and functions.
2. Learn the appropriate methods and technologies for the safe and effective application of agrochemicals in agricultural practices.
3. Analyze the environmental implications of agrochemical use, including pollution, soil degradation, and biodiversity effects, and explore strategies for minimizing negative impacts.
4. Develop skills to incorporate agrochemicals as part of an Integrated Pest Management system to achieve sustainable agricultural practices.

5. Understand the toxicological effects of agrochemicals on humans, animals, and ecosystems, and learn best practices for handling and storage to ensure safety.

THEORY

UNIT I: An introduction to agrochemicals, their type and role in agriculture, effect on environment, soil, human and animal health, merits and demerits of their uses in agriculture, management of agrochemicals for sustainable agriculture.

UNIT II: Herbicides -Major classes, properties and important herbicides. Fate of herbicides. Fungicides- classification –Inorganic fungicides-characteristics, preparation and use of sulphur and copper. Mode of action- Bordeaux mixture and copper oxychloride. Organic fungicides –Mode of action –Dithiocarbamates- characteristics, preparation and use of Zineb and maneb. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use.

UNIT III: Introduction and classification and insecticides: inorganic and organic insecticides organochlorine, Organophosphates, Carbamates, Synthetic pyrethroids Neonicotinoids, Biorationals. Insecticide Act and rules, Insecticides banned, withdrawn and restricted use. Fate of insecticides in soil and plant. IGR Biopesticides, Reduced risk insecticides, Botanical, Plant and animal systemic insecticides their characteristics and uses.

UNIT IV: Fertilizers and their importance. Nitrogenous fertilizers: Feedstocks and Manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea. Slow release N-fertilizers. Phosphatic fertilizers: feedstock and manufacturing of single superphosphate. Preparation of bone meal and basic slag. Potassic fertilizers: Natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate. Mixed and complex fertilizers: Sources and compatibility preparation of major, secondary and micronutrient mixtures. Complex fertilizers: Manufacturing of ammonium phosphates, nitro phosphates and NPK complexes.

UNIT V: Fertilizer control order. Fertilizer logistic and marketing. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

PRACTICAL

1. Sampling of fertilizers and pesticides.
2. Pesticides application technology to study about various pesticides appliances.
3. Quick tests for identification of common fertilizers.
4. Identification of anion and cation in fertilizer.
5. Calculation of doses of insecticides to be used.
6. To study and identify various formulations of insecticide available in market.
7. Estimation of nitrogen in Urea.
8. Estimation of water soluble P_2O_5 and citrate soluble P_2O_5 in single super phosphate.
9. Estimation of potassium in Murate of Potash/ Sulphate of Potash by flame photometer.
10. Determination of copper content in copper oxychloride.
11. Determination of sulphur content in sulphur fungicide.

Suggested readings

1. Buchel, K.H. (Ed.). 1992. Chemistry of pesticides. John Wiley & Sons

2. Panda, H. 2022. The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & Equipment Details. 2nd Revised Edition. NPCS
3. Biswas, D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
4. Singh, A. 2022. Basics of Agrochemical Formulations, Brillion Publishing, 176p.
5. Larramendy, M.L. 2017. Toxicity and Hazard of Agrochemicals, INTECH, 170p.

Protected Cultivation	HORT-701	4(3+1)
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Course Outcomes:

1. To educate students on the scientific and commercial cultivation of important value-added products in protected cultivation

Theory

Unit I: Protected cultivation- importance and scope, status of protected cultivation in India and World, types of protected structure based on site and climate.

Unit II: Cladding material involved in greenhouse/ poly house. Greenhouse design, environment control, artificial lights, Automation. Soil preparation and management, Substrate management.

Unit III: Types of benches and containers, Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops.

Unit IV: Greenhouse cultivation of important horticultural crops-rose, carnation, chrysanthemum, gerbera, orchid, anthurium, liliun, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc.

Unit V: Cultivation of economically important medicinal and aromatic plants. Off- season production of flowers and vegetables. Insect pest and disease management.

Practical

Raising of seedlings and saplings under protected conditions, Use of portrays in quality planting material production, Bed preparation and planting of crop for production. Inter cultural operations, Soil EC and pH measurement. Regulation of irrigation and fertilizers through drip, fogging and misting.

Suggested readings

1. Greenhouse operation and management by Paul V. Nelson.
2. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and Manju Rani Sahu.
3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS.
4. Advances in Protected Cultivation by Brahma Singh and Balraj Singh. NIPA, 252p.
5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar. New Delhi Publishers, 263p.
6. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops by B. Ashok Kumar, Eggadi Ramesh and Sindhu V. Jain Brothers.

Course Outcomes:

1. To teach students the principles of crop production under organic and conservation agriculture situation
2. To impart practical knowledge of organic and conservation agriculture practices

Theory

Unit I: Concept of organic farming, principles and its scope in India; Choice of crops and varieties in organic farming; Nutrient management in organic farming and their sources;

Unit II: Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP;

Unit III: Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.

Unit IV: Conservation agriculture: definition, origin, principles, advantages, challenges; Primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices, conservation agriculture vis a vis Climate Smart Agriculture;

Unit V: Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops.

Practical:

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost and their quality analysis; Method of application of bio-fertilizers; Indigenous technology knowledge (ITK) for nutrient, insect-pest and disease management; Studies in green manuring in-situ and green leaf manuring, Studies on different type of botanicals for insect- pest management; Weed management in organic farming; Cost of organic production system; Practices of conservation agriculture.

Suggested readings

1. A.C. Gaur. Handbook of Organic farming and biofertilizers.
2. A.K. Dahama. Organic Farming for Sustainable Agriculture. Agrobios (India), Jodhpur.
3. Arun. K. Sharma. Handbook of Organic Farming. Agrobios (India), Jodhpur.
4. S.P. Palaniappan and K. Annadurai. Organic Farming – Theory and Practice. Scientific Publishers. Jodhpur.
5. U. Thapa and P. Tripathy. Organic Farming in India- Problems and Prospects. Agrotech publishing agency, Udaipur.
6. G.K. Veeresh. Organic Farming. Foundation Books. New Delhi.

Course Outcome:

2. Interpret community nutrition and health outcomes
3. Gain knowledge on food security
4. Understand the methods of Nutrition assessment
5. Gain knowledge on major nutritional deficiencies and learn about their prevention.
6. Enables the students to learn the importance of Balanced diet, Meal planning at different phases of life. It also teaches the tools of Nutritional assessment, screening and the role of different nutritional agencies for the up liftment of the health.

Theory

Unit I: Introduction on fundamentals of foods and human nutrition; Basic food groups; Concept of balanced diets; Recommended Daily Allowances (RDA) for various age groups;

Unit II: Biochemical composition, energy and food value of various food grains, fruits and vegetables; Carbohydrates, proteins, fats as nutrients and their interactions;

Unit III: Physio-chemical, functional and nutritional characteristics of essential nutrients-sources and functions, Nutritional requirements, malnutrition, inborn errors of metabolism, deficiency diseases;

Unit IV: Digestion, absorption, transport and metabolism of nutrients in human system; Protein quality evaluation. Biochemical and nutritional aspects of vitamins, minerals, nutraceuticals, antioxidant, antinutritional factors and biochemistry of post-harvest storage.

Unit V: losses during processing. Effect of cooking, processing and preservation on nutrients of different food products, biochemical aspects of food spoilage; Food fads, food safety and quality standards. Enzymes in food industry, food additives, nutritional quality of plant, animal, dairy, marine and fermented products.

Practical

1. Proximate analysis of foods;
2. Calorific value of foods;
3. Estimation of vitamins,
4. Estimation of phenols and flavonoids,
5. Estimation of carotenoids,
6. Estimation of antinutrients like Phytate/ Oxallate,
7. Estimation of Trypsin and Chymotrypsin inhibitor activities,
8. Estimation of limiting amino acids in food stuff.

Suggested readings

1. Damodaran, S. and Parkin, K.L. (Ed.). 2017. Fennema's Food Chemistry. CRC Press
2. Gibney, M.J., Lanham-New, S.A., Cassidy, A. and Voster, H.H. (Ed.). 2009. Introduction to Human Nutrition. Wiley-Blackwell.
3. Trueman, P. 2007. Nutritional Biochemistry. MJP Publishers.

4. Rekhi, Tejmeet and Yadav, Heena. 2014. Fundamentals of Food and Nutrition. Elite Publishing House. 257p.
5. Dharmesh Kumar. Food Science and Nutrition. Random.

EIGHT SEMESTER

S. No.	Subject Name	Subject Code	Credit Hours
1.	Student READY : RAWE/ Industrial Attachment /Experiential Learning / Hands-on Training/ Project Work / Internship		20(0+20)
2.	Online Course		4