

FACULTY OF AGRICULTURAL SCIENCES

SYLLABUS (2020-21)

B.Sc. (Hons.) Agriculture



**SHREE GURU GOBIND SINGH TRICENTENARY
UNIVERSITY**

1st year/1st semester
Fundamentals of Agronomy
Paper code 11010101
Credits 4(3+1)

Theory:

Unit –1

Agronomy and its scope, plant growth and development– concept and differences, general growth curves, Factor affecting growth and development, seeds and sowing, tillage and tilth, crop density and geometry.

Unit-2

Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant-water relationship, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods, quality of irrigation water, water logging.

Unit-3

Weeds- importance, classification, crop-weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy. Herbicide formulations, method of application; introduction to adjuvants and their uses in herbicides.

Unit-4

Plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.

Practical

Identification of crops, seeds, fertilizers, pesticides and tillage implements, study of agroclimatic zones of India, Identification of weeds in crops, Methods of herbicide and fertilizer application, Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements- reversible plough, one way plough, harrow, leveler, seed drill, Measurement of irrigation water.

Suggested Readings:

Sr. No.	Books
1.	Balasubramanian, P and Palaniappan, S.P. 2001. Principles and Practices of Agronomy. AgroBios (India) Ltd., Jodhpur.
2.	Brady, N.C. and Well, R.R. 2002. The Nature and Properties of Soils (13th ed.). Pearson Education, Delhi.
3.	De, G.C.1989. Fundamentals of Agronomy. Oxford and IBH Publishing Co., New Delhi.
4.	Reddy. T.Y and Reddy, G.H.S.1995. Principles of Agronomy, Kalyani Publishers, Ludhiana.
5.	Khadekar, S.R. 2001. Meteorology. Agromet publishers, Nagpur

1st year/1st semester
Introduction to Forestry
Paper code 11010102
Credits 2(1+1)

Theory

Unit –1

Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification, salient features of Indian Forest Policies.

Unit –2

Forest regeneration, Natural regeneration -natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Crown classification.

Unit –3

Tending operations – weeding, cleaning, thinning –mechanical, ordinary, crown and advance thinning. Forest mensuration – objectives, diameter measurement, instruments used in diameter measurement; Non instrumental methods of height measurement - shadow and single pole method; Instrumental methods of height measurement- geometric and trigonometric principles, instruments used in height measurement; tree stem form, form factor, form quotient, measurement of volume of felled and standing trees, age determination of trees.

Unit –4

Agroforestry – definitions, importance, criteria of selection of trees in agroforestry, different agroforestry systems prevalent in the country, shifting cultivation, taungya, alley cropping, wind breaks and shelter belts, home gardens. Cultivation practices of two important fast growing tree species of the region.

Practical:

Identification of tree-species. Diameter measurements using calipers and tape, diameter measurements of forked, buttressed, fluted and leaning trees. Height measurement of standing trees by shadow method, single pole method and hypsometer. Volume measurement of logs using various formulae. Nursery lay out, seed sowing, vegetative propagation techniques. Forest plantations and their management. Visits of nearby forest based industries.

Suggested Readings:

Sr. No.	Books
1.	Subba Rao, N.S. 1999 .Biofertilizers in Agricultural and Agro forestry .Oxford and IBH , New Delhi.
2.	Grebner, D, Bettinger, P and Siry, J. Introduction to Forestry and Natural Resources Academic Press.
3.	Edmonds, R.L, Agee, J. K. and Gara, R.I. Forest Health and Protection
4.	P. K. R. Nair, 1993, An introduction to agroforestry
5.	Buck, L., Lassoie, J.P., Fernandes and E.C.M., 1998. Agroforestry in Sustainable Agricultural Systems

1st year/1st semester
Fundamentals of Plant Biochemistry and Biotechnology
Paper code: 11010103
Credits 3(2+1)

Theory:

Unit –1

Importance of Biochemistry. Properties of water, pH and buffer. Carbohydrate: importance and classification. Structures of monosaccharides, disaccharides and polysaccharides.

Unit –2

Lipid: importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: structural organization and classification of proteins. Enzymes: general properties and classification, titration and zwitterions nature of amino acids; Michaelis & Menten and Line Weaver Burk equation; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; A, B & Z DNA; RNA. Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids

Unit –3

Concepts and applications of plant biotechnology: Scope, organ culture, embryo culture, cell suspension culture, callus culture, anther culture, pollen culture and ovule culture and their applications; Micro-propagation methods; organogenesis and embryogenesis, Synthetic seeds and their significance; Embryo rescue and its significance; Somatic hybridization and cybrids; Somaclonal variation and its use in crop improvement; Cryo-preservation.

Unit –4

Introduction to recombinant DNA methods: physical (gene gun method), chemical (PEG mediated) and *Agrobacterium* mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Biotechnology regulations.

Practical

Preparation of solution, pH & buffers, qualitative tests of carbohydrates, lipid and amino acids, Quantitative estimation of glucose/ proteins. Titration methods for estimation of amino acids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides. Sterilization techniques. sterilization techniques. Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro-propagation technique. hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

Suggested Readings:

Sr. No.	Books
1.	Conn EE and Stumpf PK, 1989, Outline of Biochemistry, Wiley Eastern Ltd. New Delhi.
2.	Jain JL, 2004, Fundamentals of Biochemistry, 5 th edn, S.Chand and Company, New Delhi
3.	David L. Nelson and Michael M. Cox, 2009, Lehninger Principles of Biochemistry, 5 th edn, WH freeman.
4.	Bhojwani SS and Razdan MK, 1996, Plant Tissue Culture theory and practice, Elsevier publishers.

1st year/1st semester
Fundamentals of Soil Science
Paper code 11010104
Credits 3(2+1)

Theory

Unit- 1

Soil as a natural body, Pedological and edaphological concepts of soil; Soil genesis: Elementary knowledge of soil taxonomy classification and soils of India; soil forming rocks and minerals; weathering, processes and factors of soil formation; Soil Profile, components of soil.

Unit- 2

Soil physical properties: soil-texture, structure, density and porosity, soil colour, consistency and plasticity; Soil water retention, movement and availability; Soil air, composition, gaseous exchange, problem and plant growth, Soil temperature; source, amount and flow of heat in soil; effect on plant growth.

Unit- 3

Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability; soil colloids-inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation.

Unit- 4

Soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and micro organisms, their beneficial and harmful effects; Soil pollution - behavior of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil texture by feel and Bouyoucos methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Estimation of organic matter content of soil.

Suggested Readings:

Sr. No.	Books
1.	Biswas, T.D. and Mukherjee, S.K. 2001. Text Book of Soil Science. Tata McGraw Hill Publishing Co., New Delhi
2.	Brady, N.C. 1990. Nature and Properties of Soils. 10th Edn, Macmillian Publishing Co. Inc., New York
3.	Das.D.K, 1997. Introductory Soil Science. Kalyani Publishers, New Delhi.
4.	Foth, H.D. and Turk, L. M. 1972. Fundamental of Soil Science. 5th Edn. Wiley Eastern Pvt. Ltd., New Delhi
5.	Gupta, P.K. 2007. Soil, Plant, Water and Fertilizer Analysis. Published by AGROBIOS (India), Jodpur

1st year/1st semester
Fundamentals of Entomology
Paper code 11010105
Credits 3(2+1)

Theory

Unit –1

History of Entomology in India. Characters of phylum Arthropoda and its important classes, Factors responsible for insect dominance in animal kingdom. Importance of insects. 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. Major sensory organs like simple and compound eyes, chemo-receptors.

Unit-2

Diapause in insects. Types of larvae and pupae. Structure and functions of digestive, reproductive (structure of male and female genital organs, types of reproduction), circulatory, nervous, respiratory and excretory systems in insects.

Unit-3

Introduction of systematics, Taxonomy its importance, and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Metamorphosis

Unit-4

Classification of class Insecta up to orders and families of agricultural importance like Orthoptera: (Acrididae, Tettigonidae, 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, Bruchidae, Scarabaeidae and Curculionidae); 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/cockroach. Types and modifications of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae; Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importance. Dissection of digestive system in insects (Grasshopper)/cockroach; Dissection of male and female reproductive systems in insects (Grasshopper).

Suggested Readings:

Sr. No.	Books
1.	Chapman, R.F. 1988. Insects: Structure and Function. Cambridge Univ. Press, UK.
2.	Mani, M. S. 1968. General Entomology. Oxford and IBH Publishing Company, New Delhi. 912 p.
3.	Richards, O.W. and Davies, R. G. 1977. Imm's General Text Book of Entomology, Vol.1 and 2, Chapman and Hill Publication, London, 1345p.
4.	Srivastava, P. D. and Singh, R. P. 1997. An Introduction to Entomology, Concept Publishing Company, New Delhi, 269p
5.	Charles A Triplehom and Norman F. Johnson 2005 Borror and De Long's Introduction to the Study of Insects Thomson Brooks/Cole Publishing. U.S.A.

1st year/1st semester
Comprehension & Communication Skills in English
Paper code 11010106
Credits 2(1+1)

Theory

Unit –1

Reading Comprehension: War Minus Shooting- The sporting Spirit. A Dilemma- A layman looks at science Raymond, B. Fosdick. You and Your English – Spoken English and Broken English by G.B. Shaw.

Unit –2

Vocabulary Building: Antonym, Synonym, Homophones, Homonyms, often confused words. Exercises to help the students in the enrichment of vocabulary based on TOEFL and other competitive examinations.

Unit –3

Functional grammar: Articles, Prepositions, Verb, Subject-verb Agreement, Transformation, Synthesis, Direct and Indirect Narration.

Unit –4

Written Skills: Paragraph writing, Precise writing, Report writing and Proposal writing. The Style: Importance of professional writing. Preparation of Curriculum Vitae and Job applications. Synopsis Writing.

Practical

Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice and Attitude Reading skills: reading dialogues, rapid reading, intensive reading, improving reading skills. Presentation Skills: Types of presentation, Strategies of Presentation, Making presentations. Mock Interviews and Group Discussion: testing initiative, team spirit, leadership, intellectual ability, Group discussion practice.

Suggested Readings:

Sr. No.	Books
1.	Krishnaswamy N. and Sriraman, T. 1995. Current english for colleges, macmillan India Limited, Madras
2.	A Dilemma: A layman looks at science raymond B. Fosdick
3.	V.N Arora & Laxmi Chandra, 2001, Improve your writing, Oxford University press, New Delhi.

1st year/1st semester
Introductory Biology*
Paper code 11010107
Credits 2(1+1)

Theory

Unit –1

Introduction to the living world, diversity and characteristics of life, origin of life,

Unit –2

Evolution and Eugenics. Binomial nomenclature and classification Cell and cell division.

Unit –3

Morphology of flowering plants. Seed and seed germination.

Unit –4

Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture.

Practical

Morphology of flowering plants – root, stem and leaf and their modifications. Inflorescence, flower and fruits. Cell, tissues & cell division. Internal structure of root, stem and leaf. Study of specimens and slides. Description of plants - Brassicaceae, Fabaceae and Poaceae.

Suggested Readings:

Sr. No.	Books
1.	A.C. Dutta: Text Book of Botany (Latest Ed.). Oxford University Press- India, 2000.
2.	Vidarthi: Text Book of Botany Part – I. S. Chand and Company, New Delhi, 2002.
3.	Widge and Bhatia: Introduction of Botany. Truman Publishers, Jalandhar, 2010.
4.	Bhojwani, S.S. and Bhatnagar, S.P., 1992, The Embryology of Angiosperms, Vikas Publishing House, New Delhi.

1st year/1st semester
Elementary Mathematics*
Paper code 11010108
Credits 2(2+0)

Theory:

Unit 1

Algebra: Properties of determinants upto 3rd order and their evaluation. Definition of matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order and their properties.

Straight lines : Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral. **Circle:**

Unit 2

Co- ordinate geometry: Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x_1, y_1) & (x_2, y_2) , Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$.

Unit 3

Trigonometry: Trigonometric ratios of five standard angles; allied angles, addition and subtraction formulae, sum and product formulae; t-ratios of multiple and sub -multiple angles; **Differential Calculus :** Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity.

Unit-4

Calculus: Differentiation of x^n , e^x , $\sin x$, $\cos x$ from first principle, Derivative of sum, difference, product and quotient of two function, Differentiation of function of function, logarithmic, substitution, inverse Trigonometry, Elementary integration, integration by substitution and by parts; definite integrals properties. **Integral Calculus :** Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

Suggested Readings:

Sr. No.	Books
1.	Algebra by D. C. Kapoor and Gurbax Singh
2.	Algebra by T. N. Nagpal and K. K. Gupta.
3.	Comprehensive Calculus by R. S. Dahiya.
4.	New Style Calculus for T. D. C. – I.
5.	New Style coordinator Geometry by R. K. Sondhi

1st year/1st semester
Agricultural Heritage
Paper code 11010109
Credits 1(1+0)

Unit –1

Introduction of Indian agricultural heritage; Ancient agricultural practices, Relevance of heritage to present day agriculture; past and present status of agriculture and farmers in society

Unit –2

Journey of Indian agriculture and its development from past to modern era; Plant production and protection through indigenous traditional knowledge (ITK)

Unit –3

Crop voyage in India and world; Agriculture scope; Importance of agriculture and agricultural resources available in India; Crop significance and classifications

Unit –4

National agriculture setup in India; Current scenario of Indian agriculture; Indian agricultural concerns and future prospects.

Suggested Readings:

Sr. No.	Books
1.	Ahmed, S. 2004. Gender Issues in Agricultural and Rural Livelihoods-Vol. I M.S. Swaminathan Research Foundation, Chennai and Kerala Agricultural University, Thrissur.
2.	Commonwealth Secretariat. 1996. Women and Natural Resource Management: A Manual for the Asian Region. Gender and Youth Affairs Division, London.
3.	FAO [Food and Agriculture Organization of the United Nations]. 2001. Field Level Handbook, SEAGA Socio-Economic and Gender Analysis Programme. FAO, Rome (Available: http://www.fao.org/sd/seaga/downloads/En/fieldEn.pdf).
4.	Husain, M. 1996. Systematic Agricultural Geography. Rawat Publications, Jaipur
5.	Noor Mohammed. 1992. Origin, diffusion and development of agriculture. In: Noor Mohammed (ed.), New Dimensions in Agricultural Geography: Vol.1. Historical Dimensions of Agriculture. Concept Publishing Co., New Delhi. Pp29-75.

1st year/1st semester
Rural Sociology & Educational Psychology
Paper code 11010110
Credits 2(2+0)

Theory

Unit –1

Sociology and Rural sociology: Definition and scope, its significance in agriculture extension

Unit –2

Social Ecology, Rural society, Social Groups, Social Stratification

Unit-3

Culture concept, Social Institution, Social Change & Development.

Unit –4

Educational psychology: Meaning & its importance in agriculture extension. Behavior: Cognitive, affective, psychomotor domain, Personality, Learning, Motivation, Theories of Motivation, Intelligence.

Suggested Readings:

Sr. No.	Books
1.	Desai A. R, 2003, Rural Sociology in India. Popular Parkasan, Bombay.
2.	Samanta. R. K. and Arora, S. K., 1997, An Introduction to Sociology. Kitab Mahal S.D.Pvt. Ltd., Allahabad.
3.	Doshi, S. L. and P. C. Jain, 2016, Rural Sociology, Rawat Publications, Jaipur.
4.	Mondal, S. and Ray G. L., 2007, A Text Book of Rural Development. Kalyani Publishers, Chennai.

1st year/ 1st semester
Human values and ethics
Paper code 11010111
Credits 1(1+0)

Theory

UNIT -1

Values and Ethics-An Introduction. Goal and Mission of Life. Vision of Life. Principles and Philosophy. Self-Exploration. Self-Awareness. Self-Satisfaction. Decision Making.

UNIT -2

Motivation. Sensitivity. Success. Selfless Service. Case Study of Ethical Lives. Positive Spirit. Body, Mind and Soul. Attachment and Detachment. Spirituality Quotient. Examination.

Suggested Readings

- Gaur RR, Sangal R & Bagaria GP. 2011. A Foundation Course in Human Values and Professional Ethics. Excel Books.
- Mathur SS. 2010. Education for Values, Environment and Human Rights. RSA International.
- Sharma RA. 2011. Human Values and Education -Axiology, Inculcation and Research. R. Lall Book Depot.
- Sharma RP & Sharma M. 2011. Value Education and Professional Ethics. Kanishka Publishers.
- Srivastava S. 2011. Human Values and Professional Ethics. S K Kataria & Sons.
- Srivastava S. 2011. Environmental Science. S K Kataria & Sons.
- Tripathi A.N. 2009. Human Values. New Age International (P) Ltd Publishers.

1st year/ 1st semester
Physical Education & Yoga Practices
Paper code 11010112
Credits 2 (0+2)

Theory

Unit –1

Teaching of skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit) Teaching of different skills of Football – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit) Teaching of advance skills of Football – involvement of all the skills in game situation with teaching of rules of the game Teaching of skills of Basketball – demonstration, practice of the skills, correction of skills, involvement in game situation Teaching of skills of Basketball – demonstration, practice of the skills, involvement in game situation. Teaching of skills of Basketball – involvement of all the skills in game situation with teaching of rule of the game

Unit –2

Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation Teaching of advance skills of Kabaddi – involvement of all the skills in game situation with teaching of rule of the game Teaching of skills of Ball Badminton – demonstration, practice of the skills, correction of skills, involvement in game situation Teaching of skills of Ball Badminton – involvement of all the skills in game situation with teaching of rule of the game

Unit –3

Teaching of some of Asanas – demonstration, practice, correction and practice Teaching of some more of Asanas – demonstration, practice, correction and practice Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation Teaching of skills of Table Tennis – demonstration, practice of skills, correction and practice and involvement in game situation Teaching of skills of Table Tennis – involvement of all the skills in game situation with teaching of rule of the game

Unit –4

Teaching – Meaning, Scope and importance of Physical Education Teaching – Definition, Type of Tournaments Teaching – Physical Fitness and Health Education Construction and laying out of the track and field (*The girls will have Tennikoit and Throw Ball).

Note: 1) Compulsory Uniform: Half pants, Tee Shirts, Shoes and socks all white (Girls will have white Tee Shirt and Track pants) 2) The games mentioned in the practical may be inter changed depending on the season and facilities.

1st year/ 2nd semester
Fundamentals of Genetics
Paper code 11010201
Credits 3(2+1)

Theory

Unit –1

Pre and Post Mendelian concepts of heredity and Mendelian principles of heredity. Architecture of chromosome i.e. chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; special types of chromosomes and Chromosomal theory of inheritance.

Unit –2

Cell cycle and cell division- mitosis and meiosis. Probability and Chi-square Test. Dominance relationships and Epistatic interactions with example. Multiple alleles, pleiotropism and pseudo alleles, Sex determination and sex linkage, sex limited and sex influenced traits, Blood group genetics.

Unit –3

Linkage and its estimation, crossing over mechanisms and chromosome mapping. Structural and numerical variations in chromosome and their implications, Use of haploids, dihaploids and doubled haploids in Genetics. Mutation, classification, Methods of inducing mutations & CIB technique and mutagenic agents. Qualitative & Quantitative traits, Polygenes and continuous variations and multiple factor hypotheses.

Unit –4

Cytoplasmic inheritance. Genetic disorders. Nature, structure & replication of genetic material. Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation, Lac and Trp operon.

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 and three point test cross data). Study on sex linked inheritance in Drosophila. Study of models on DNA and RNA structures.

Suggested Readings:

Sr. No.	Books
1.	Gupta, P. K. 2007. Cytogenetics Rastogi Publishers, Meerut
2.	Phundan Singh 1995, Elements of genetics Kalyani Publishers, Ludhiana
3.	Strickberger, M.W. 1996. Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi
4.	Singh B. D., Genetics. Kalyani publisher, New Delhi.
5.	Winchester A M 1967 Genetics (3 rd edn)Oxford and IBH Publishing Co New Delhi

1st year/ 2nd semester
Agricultural Microbiology
Paper code 11010202
Credits 2(1+1)

Theory

Unit –1

Introduction to microbial world: Prokaryotic and eukaryotic microbes.

Unit –2

Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial genetics: genetic recombination transformation, conjugation and transduction, plasmids, transposon.

Unit –3

Role of microbes in soil fertility and crop production: Carbon, nitrogen, phosphorus and sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, bluegreen algae and mycorrhiza. Rhizosphere and phyllosphere.

Unit –4

Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste.

Practical

Introduction to microbiology laboratory and its equipments; Microscope- parts, principles of microscopy, resolving power and numerical aperture. Methods of sterilization. Nutritional media and their preparations. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes. Methods of isolation and purification of microbial cultures. Isolation of *Rhizobium* from legume root nodule. Isolation of *Azotobacter* from soil. Isolation of *Azospirillum* from roots. Isolation of BGA. Staining and microscopic examination of microbes.

Suggested Readings:

Sr. No.	Books
1.	Pelczar MJ, Chan ECS and Kreig NR, 1998, Microbiology. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
2.	Stanier RY, Ingraham, Wheelis MG and Paintor PR, 1986, The Microbiology World, Prentice Hall, New Jersey.
3.	Tauro P, Kapoor KK and Yadav KS, 1989, An Introduction to Microbiology, Wiley Publications, New Delhi.
4.	Alexander M, 1985, Introduction to Soil Microbiology, John Wiley and Sons, New York.
5.	Subba Rao, NS, 1999, Biofertilizers in Agricultural and Agroforestry, Oxford and IBH, New Delhi.

1st year/ 2nd semester
Soil and Water Conservation Engineering
Paper code 11010203
Credits 2(1+1)

Theory

Unit –1

Introduction to Soil and Water Conservation causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion.

Unit –2

Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation, Soil loss measurement techniques.

Unit –3

Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques.

Unit –4

Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.

Practical

General status of soil conservation in India Calculation of erosion index. Estimation of soil loss. Measurement of soil loss. Preparation of contour maps. Design of grassed water ways. Design of contour bunds. Design of graded bunds. Design of bench terracing system. Problem on wind erosion.

Suggested Readings:

Sr. No.	Books
1.	Kanetkar, Kulkarni, 2005, Surveying and leveling, AVG Prakasan, 23rd edition .
2.	Ojha, T.P. and A.M. Michael, 2001, Principles of Agricultural Engineering, 3rd edition, Vol.II. Jain Brothers New Delhi.
3.	Singhal, O.P., 1997, Agricultural Engineering.

1st year/ 2nd semester
Fundamentals of Crop Physiology
Paper code 11010204
Credits 2(1+1)

Theory

Unit –1

Introduction to crop physiology and its importance in agriculture; Plant cell: an overview; diffusion and osmosis; Absorption of water, transpiration and stomataphysiology.

Unit –2

Mineral nutrition of Plants: Functions and deficiency symptoms of nutrients, nutrient uptake mechanisms; Photosynthesis: Light and dark reactions, C3, C4 and CAM plants.

Unit –3

Respiration: Glycolysis, TCA cycle and electron transport chain; Fat metabolism: Fatty acid synthesis and breakdown

Unit –4

Plant growth regulators: physiological roles and agricultural uses, physiological aspects of growth and development of major crops: growth analysis, role of physiological growth parameters in crop productivity

Practical

Study of plant cells, structure and distribution of stomata, imbibitions, osmosis, plasmolysis, measurement of root pressure, rate of transpiration, separation of photosynthetic pigments through paper chromatography, Rate of transpiration, photosynthesis, respiration, tissue test for mineral nutrients, estimation of relative water content. Measurement of photosynthetic CO₂ assimilation by Infra-Red Gas Analyser (IRGA).

Suggested Readings:

Sr. No.	Books
1.	Lincoln Taiz and Eduardo Zeiger, 2002, Plant Physiology, 3rd ed, Sinauer Associates
2.	Pessarakli M, 2003, Hand Book of Plant and Crop Physiology, Marcel Dekker, Inc., New York.
3.	Hans Mohr and Peter Schopfer, 1995, Plant physiology, Springer Publications.

1st year/ 2nd semester
Fundamentals of Agricultural Economics
Paper code 11010205
Credits 2(2+0)

Theory

Unit –1

Economics: Meaning, scope and subject matter, definitions, activities, approaches to economic analysis; micro and macroeconomics, positive and normative analysis. Nature of economic theory; rationality assumption, concept of equilibrium, economic laws as generalization of human behavior.

Unit –2

Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare. Agricultural economics: meaning, definition, characteristics of agriculture, importance and its role in economic development. Agricultural planning and development in the country.

Unit –3

Demand: meaning, law of 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. 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. *Cost*: concepts, short run and long run cost curves. *Supply*: Stock v/s supply, law of supply, schedule, supply curve, determinants of supply, elasticity of supply.

Unit –4

National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. *Money*: Barter system of exchange and its problems, evolution, meaning and functions of money, classification of money, supply, general price index, inflation and deflation. *Banking*: Role in modern economy, types of banks, functions of commercial and central bank, credit creation policy. *Tax*: meaning, direct and indirect taxes, agricultural taxation, GST. *Economic systems*: Concepts of economy and its functions, elements of economic planning.

Suggested Readings:

Sr. No.	Books
1.	Dewett, K.K. 2005. Modern Economic Theory. S. Chand, New Delhi.
2.	Dewett, K.K., Verma. 2004 Elementary Economic Theory, S.Chand, New Delhi
3.	Jhingam, M. L. 2001. Micro Economic Theory. Konark publishers, New Delhi
4.	Kenneth, E.B. 1941. Economic Analysis. Harper and Row, New York.
5.	Reddy, S., Raghuram, P., Neelakantan, T.V., Bhavani D. I. 2004. Agricultural Economics..Oxford and IBH Publishers, New Delhi.

1st year/ 2nd semester
Fundamentals of Plant Pathology
Paper code 11010206
Credits 4(3+1)

Theory

Unit –1

Introduction: History, Scope and objectives of Plant Pathology with special reference to Indian work. Importance, concepts and classification of plant diseases. Terms and concepts in Plant Pathology. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes. Causes / factors affecting disease development: disease triangle and tetrahedron.

Unit –2

Fungi: Definition of fungus, general characters, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction (asexual and sexual). Binomial system of nomenclature, rules of nomenclature, classification of fungi. *Bacteria:* general morphological character and basic methods of classification and reproduction.

Unit –3

Viruses: Nature, structure, replication and transmission. Study of phanerogamic plant parasites. *Nematodes:* General morphology and reproduction, symptoms and nature of damage caused by plant nematodes (*Heterodera, Meloidogyne, Anguina, Radopholus* etc.) Liberation / dispersal and survival of plant pathogens.

Unit –4

Types of parasitism and variability in plant pathogens. Pathogenesis. Role of enzymes, toxins and growth regulators in disease development. Defense mechanism in plants. Epidemiology: Factors affecting disease development. Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipment's and microscopy. Collection and preservation of disease specimen. Preparation of media, isolation and Koch's postulates. General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of morphological features and identification of plant parasitic nematodes. Sampling and extraction of nematodes from soil. Study of fungicides and their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

Suggested Readings:

Sr. No.	Books
1.	Agrios, G.N. 2003. Plant Pathology Academy Press. New York.
2.	Dasgupta, M.K. 1998. Principles of Plant Pathology. Allied Publishers Pvt. Ltd. Bangalore
3.	Walia, Raman K. and Bajaj, Harish K., 2003, Textbook on Introductory Plant Nematology, Directorate of Information and Publications of Agriculture, ICAR, New Delhi
4.	Nene, Y.L. and Thapliyal, P.N. 1998. Fungicides in Plant Disease Control. Oxford and IBH New Delhi
5.	Singh. R.S 2002. Introduction to Principles of Plant Pathology. Oxford and IBH Publishing, New Delhi

1st year/ 2nd semester
Insect Ecology and Pest Management
Paper code 11010207
Credits 3(2+1)

Theory

Unit –1

Insect Ecology: Introduction, Environment and its components. Effect of abiotic factors– temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents.

Unit –2

Effect of biotic factors – food competition, natural and environmental resistance.

Unit –3

Classification of insecticides, toxicity and formulations of insecticides. Symptoms of poisoning, first aid and antidotes. Categories of pests. Concepts, scope and limitations of IPM. Importance of Chemical control, hazards and limitations.

Unit –4

Recent methods of pest control, repellents, anti-feedants, hormones, attractants, gamma radiation. Insecticide application equipments and techniques of spray fluids. Insecticides Act 1968.

Practical

Insecticides and their formulations. Pesticide application equipments and their maintenance. Types spray nozzles and their use. Survey surveillance and Sampling techniques of insect population for estimation of damage and loss. Demonstrations of Integrated Pest Management Techniques.

Suggested Readings:

Sr. No.	Books
1.	Atwal, A. S and Bains, S. S. 1989. Applied Animal Ecology. Kalyani Publishers. New Delhi. 245p
2.	David, B.V. and Kumaraswami, T. 1996 Elements of Economic Entomology. Popular Book Depot, Madras. 536 p.
3.	Dhaliwal, G. S. and Ramesh Arora. 1998. Principles of Insect Pest Management. Kalyani Publishers, New Delhi. 297 p.
4.	Dhaliwal, G. S. and Singh, B. 1998. Pesticides – The Ecological Impact in Developing Countries . Commonwealth Publishers, New Delhi. 256p.
5.	Metcalf, C. K. and Flint, W. P. 1970. Destructive and Useful Insects: Their Habits and Control. Tata McGraw Hill Publishing Company. New Delhi. 1074p.

1st year/ 2nd semester
Fundamentals of Agricultural Extension Education
Paper code 11010208
Credits 3(2+1)

Theory

Unit –1

Education: Meaning, definition & 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.); various extension/ agriculture development programmes launched by ICAR/Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.). New trends in agriculture extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc.

Unit –3

Rural Development: concept, meaning, definition; various rural development programs launched by Govt. of India. Community Dev.-meaning, definition, concept & principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programmes;

Unit –4

Transfer of technology: concept and models, capacity building of extension personnel; 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; handling and use of audio visual equipments and digital camera and LCD projector; 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 and other development departments at district level; visit to NGO 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 Readings:

Sr. No.	Books
1.	Dharma, O.P. and Bhatnagar, O.P 2000. Education and Communication for Development. Oxford, IBH, New Delhi
2.	Desai, A.R. 2003. Rural Sociology in India. Popular Prakashan, Bombay
3.	Khana, B.S. 1991. Rural Development in South Asia-India. Deep and Deep Publication, New Delhi.
4.	Khatari, G.R. 1991. Rural Development Vo. I and II. Marak Publications Pvt. Ltd., Delhi.
5.	Mollett, S.M. 1984. Planning for Agricultural Development. Martin Press, London.

1st year/ 2nd semester
Communication Skills and Personality Development
Paper code 11010209
Credits 2(1+1)

Theory

Unit –1

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication;

Unit –2

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

Unit –3

Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking;

Unit –4

Group discussion. Organizing seminars and conferences.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Suggested Readings:

Sr. No.	Books
1.	Krishnaswamy N. and Sriraman, T. 1995. Current english for colleges, macmillan India Limited, Madras
2.	A Dilemma: A layman looks at science raymond B. Fosdick
3.	Improve your writing, ed. V.N Arora & Laxmi Chandra, Oxford University press 2001, New Delhi.

1st year/ 2nd semester
Fundamentals of Horticulture
Paper code: 11010210
Credits 2(1+1)

Theory:

Unit –1

Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops.

Unit -2

Plant propagation-methods and propagating structures; Seed dormancy, Seed germination.

Unit -3

Principles of orchard establishment; Principles and methods of training and pruning, chilling requirement, bud dormancy, juvenility, flower bud differentiation, fruit development and fruit ripening; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy.

Unit -4

Importance of plant bio-regulators in horticulture. Irrigation – methods, Fertilizer application in horticultural crops.

Practical:

Identification of garden tools. Identification of horticultural crops. Preparation of seed bed/nursery bed. Practice of sexual and asexual methods of propagation including micro-propagation. Layout and planting of orchard. Training and pruning of fruit trees. Preparation of potting mixture. Fertilizer application in different crops. Visit to commercial nurseries/orchard

Suggested Readings:

Sr. No.	Books
1.	Chadha, K.L.2001. Hand Book of Horticulture, ICAR, New Delhi.
2.	Singh, J. 2008. Basic Horticulture, Kalyani publishers.
3.	Gupta, S. N. 2010. Instant Horticulture, Jain Brothers Publications
4.	Kumar, N. 2017. Introduction To Horticulture, Oxford & Ibh.
5.	Muthukumar, P. & R Selvakumar, R. 2017. Glaustas Horticulture, Daya Publishing House

2nd year/ 3rd semester
Crop Production Technology – I (*Kharif Crops*)
Paper code 11010301
Credits 2(1+1)

Theory

Unit –1

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops: Cereals – rice, maize, sorghum, pearl millet.

Unit –2

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops: pulses-pigeonpea, mungbean and urdbean

Unit –3

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops: oilseeds- groundnut, and soybean; fibre crops- cotton & jute;

Unit –4

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Kharif* crops: forage crops-sorghum, cowpea, cluster bean and napier.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, pigeonpea and mungbean. maize, groundnut and cotton, effect of seed size on germination and seedling vigour of kharif season crops, effect of sowing depth on germination of kharif crops, identification of weeds in *kharif* season crops, study of crop varieties and important agronomic experiments at experimental farm. study of forage experiments, morphological description of kharif season crops, visit to research centres of related crops.

Suggested Readings:

Sr. No.	Books
1.	Chatterjee, B.N. 1989. Forage Crop Production- Principles and Practices. Oxford and IBH . New Delhi.
2.	Chidida Singh, Prem Singh and Rajbir Singh. 2003. Modern Techniques of Raising Field Crops (2nd ed.). Oxford and IBH, New Delhi.
3.	Hand Book of Agriculture, 2006, ICAR New Delhi
4.	Pal, M., Deka, J., and Rai, R.K. 1996. Fundamentals of Cereal Crop Production. Tata McGraw Hill Pub., New Delhi
5.	Prasad, R. 1999. A Text Book of Rice Agronomy, Jain Brothers, New Delhi,

2nd year/ 3rd semester
Fundamentals of Plant Breeding
Paper code 11010302
Credits 3 (2+1)

Theory

Unit –1

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.

Unit –2

Domestication, Acclimatization and Introduction; Centers of origin/diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; bulk, pedigree and back cross method, Multiline concept.

Unit –3

Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement 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 –4

Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, Mutation breeding-methods and uses. Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding.

Practical

Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross pollinated crops. Emasculation and hybridization techniques in self & cross pollinated crops. Study of male sterility system. 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.

Suggested Readings:

S. No.	Books
1.	Allard, R.W. 1960. Principles of Plant Breeding. John Wiley and Sons INC. USA. Toppan Co. Ltd. Japan
2.	Choudhari, T.C. 1982. Introduction to Plant Breeding. Oxford and IBH Publishing Co., New Delhi
3.	Elliot. 1958. Plant Breeding and Cytogenetics. Mc Grow Hill. New York
4.	Hayward, M.D., Bosemark, N.O and Romagosa (eds) 1993 Plant breeding- principles and prospects Chapman and Hall, London
5.	Singh, B. D. Principles and Methods; Kalyani publisher, New Delhi.

2nd year/ 3rd semester
Agricultural Finance and Cooperation
Paper code 11010303
Credits 3(2+1)

Theory

Unit –1

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 –2

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

Unit –3

Corporation of India. 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 –4

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.

Practical

Determination of most profitable level of capital use. 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 firsthand 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.

Suggested Readings:

Sr. No.	Books
1.	Kahlon, A.S., Singh, Karam. Managing Agricultural Finance. Allied Publishers, New Delhi
2.	Reddy, S., Raghuram, P., Neelakantan, T.V and Bhavani D.I. 2004. Agricultural Economics. Oxford and IBH Publishers, New Delhi.
3.	Reddy, S., and Ram, P.R. Agricultural Finance and Management. Oxford and IBH, New Delhi.

2nd year/ 3rd semester
Agri- Informatics
Paper code 11010304
Credits 2(1+1)

Theory

Unit –1

Introduction to Computers, Operating Systems, definition and types, Applications of MSOffice for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, uses of DBMS in Agriculture

Unit-2

World Wide Web (WWW): Concepts and components. Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications, Use of ICT in Agriculture. Computer Models for understanding plant processes.

Unit-3

IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management *etc.*

Unit-4

Geospatial technology 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 using IT tools.

Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix/ Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power-point for creating, editing and presenting a scientific Document. 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). Introduction of programming languages. Hands on Crop Simulation Models (CSM) such as DSSAT/Crop-Info/CropSyst/ Wofost; Computation of water and nutrient requirements of crop using CSM and IT tools. Introduction of Geospatial Technology for generating valuable information for Agriculture. Hands on Decision Support System. Preparation of contingent crop planning.

Suggested Readings:

Sr. No.	Books
1.	Sharma K.V.S. 2001. Statistics made simple: Do it yourself on PC. Prentice Hall of India.
2.	Capron.H.L. 1996. Computers – Tools for an information age – Fourth Edition. The Benjamin / Cummings Publishing Company, Inc., New York.
3.	Peter Nortons. 2001. Introduction to Computers – Fourth Edition. Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.
4.	P.K. Sinha 2009. Computer Fundamentals-Third Edition. BPB publication

2nd year/ 3rd semester
Farm Machinery and Power
Paper code 11010305
Credits 2(1+1)

Theory

Unit –1

Status of Farm Power in India, Sources of Farm Power, I.C. engines, working principles of IC 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 –2

Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system: clutch, gear box, differential and final drive of a tractor.

Unit –3

Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture/ implement for intercultural operations.

Unit –4

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.

Suggested Readings:

Sr. No.	Books
1.	Ojha, T.P. and A.M. Michael 2001. Principles of Agricultural Engineering, Vol.I. Jain Brothers New Delhi.3rd edition
2.	Sahay, Jagdiswar. 1977. Elements of Agricultural Engineering. Agro book Agencies
3.	Singhal, O.P. 1977. Agricultural Engineering,

2nd year/ 3rd semester
Production Technology for Vegetables and Spices
Paper code 11010306
Credits 2(1+1)

Theory

Unit –1

Importance of vegetables & spices in human nutrition and national economy, types of vegetable gardens. 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 vegetables: Tomato, Brinjal, Chilli, Capsicum, Tuber crops such as Potato; Leafy vegetables such as Amaranth, spinach; Perennial vegetables.

Unit –2

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 vegetables: Cucumber, Melons, Gourds Pumpkin, French bean, Peas;

Unit –3

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 vegetables: Cole crops such as Cabbage, Cauliflower, Knol-khol; Bulb crops such as Onion, Garlic; Root crops such as Carrot, Radish, beet root.

Unit –4

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 and processing of spices: Ginger, turmeric pepper, cardamom, coriander, cumin, fenugreek, clove and cinnamon

Practical

Identification of vegetables & spice crops and their seeds. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables & spices. Fertilizers applications. Harvesting & preparation for market. Processing of spices, Economics of vegetables and spices cultivation.

Suggested Readings:

Sr. No.	Books
1.	Chadha, K. L. 2003. Handbook of Horticulture, ICAR, New Delhi.
2.	Choudhury, B.1983. Vegetables. National Book Trust, New Delhi. Das, P. C.1993. Vegetable crops in India. Kalyani Publishers
3.	Nybe, E.V, Mini Raj, N and Peter, K.V.2007. Spices. New India Publishing Agency, New Delhi.
4.	Pruthi, J. S. 2001 Minor Spices and Condiments-Crop Management and Postharvest Technology, ICAR, New Delhi, India.
5.	Thamburaj, S. and Singh, N. 2005. Vegetables, Tuber Crops and Spices. ICAR, New Delhi.

2nd year/ 3rd semester
Environmental Studies and Disaster Management
Paper code 11010307
Credits 3(2+1)

Theory

Unit –1

Multidisciplinary nature of environmental studies. Definition, scope and importance. Natural Resources: renewable and non-renewable resources. Natural resources and associated problems: a) forest resources, b) water resources, c) mineral resources, d) food resources, e) energy resources, f) land resources. Use and over-exploitation. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit –2

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession, food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit –3

Biodiversity and its conservation: Introduction, definition, genetic, species & ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, endangered and endemic species of India. Conservation of biodiversity: *in-situ* and *ex-situ* conservation of biodiversity. 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 g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Social Issues and the Environment: From Unsustainable to Sustainable development, 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. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Unit –4

Disaster Management: meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, volcanic eruptions, heat and cold waves. Climatic change: global warming, sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management: effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management and national disaster management framework. financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

Pollution case studies;field work - visit to a local area to document environmental assets river/forest/grassland/hill/mountain; visit to a local polluted site-urban/rural/industrial/agricultural.Impact of pollution on agriculture. Study of simple ecosystems-pond, river, hill slopes etc.

Suggested Readings:

Sr. No.	Books
1.	ErachBharucha, 2015. Environmental Studies, 2 nd edn, Universities Press India P Ltd-Chennai
2.	Benny Joseph, 2008. Environmental Studies, 2 nd edn, Tata McGraw-Hill Education Pvt. Ltd.
3.	Eugene Odum, 2017, Fundamentals of Ecology 5 th edn, Cengage India.
4.	Gupta SR and Singh JS, 2015, Ecology Environmental Science and Conservation, S.Chand Publisher.

2nd year/ 3rd semester
Statistical Methods
Paper code 11010308
Credits 2 (1+1)

Theory

Unit 1

Definition, uses and limitations of Statistics, concept of population and sample, concept of data types- nominal, ordinal, discrete and continuous data, Graphical presentation of data. Frequency distribution, frequency curve, frequency polygon and ogives. Measures of central tendency (Arithmetic Mean, Median and Mode), Measures of dispersion (Range, Mean deviation, Standard deviation and Coefficient of variation). Measures of skewness and kurtosis

Unit 2

Concept of bivariate data, correlation and their types, scatter diagram, Karl Pearson correlation coefficient, Spearman rank correlation coefficient, Simple linear regression analysis

Unit 3

Basic concept of probability, Simple Problems Based on Probability, Normal distribution and its properties, Concept of parameter, statistics and statistical hypothesis, null and alternative hypothesis, level of significance, type-I and type-II errors, degrees of freedom. Tests for single mean and comparison of two means, F-test and applications, Chi-square test in 2x2 contingency table, Yates correction for continuity

Unit 4

Principle of experimental design, layout, model and analysis of completely randomized design (CRD), randomized block design (RBD) and Latin square design (LSD)

Suggested Readings:

Sr. No.	Books
1.	Gupta, S.C. and Kapoor, V.K. (1997): Fundamentals of Mathematical Statistics. Sultan Chand and Sons Publisher, New Delhi.
2.	Chakravorthi, S.R. and Giri, N. (2002): Basic Statistics. South Asian Publishers, New Delhi-110014.
3.	Rangaswamy, R. (2002): A text book of Agricultural Statistics. John Wiley and Sons.
4.	Balakrishnan, N. (2002): Statistical Methods and Practice. Prentice Hall of India.
5.	Ferrolld, H. Zar. (2005): Biostatistical Analysis: Fourth Edition, Pearson Education, India.

2nd year/ 3rd semester
Livestock and Poultry Management
Paper code 11010309
Credits 4(3+1)

Theory

Unit –1

Role of livestock in the national economy. Present status and future prospectus of various livestock programme. Reproduction in farm animals and poultry. Housing principles, space requirements for different species of livestock and poultry.

Unit –2

Management of calves, growing heifers and milch animals. Management of sheep, goat and swine. Incubation, hatching and brooding. Management of growers and layers.

Unit –3

Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine and poultry. Improvement of farm animals and poultry. Digestion in livestock and poultry. Classification of feedstuffs. Proximate principles of feed.

Unit –4

Feeding and management of calves, growing heifers and milch animals etc. 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 equipments. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production.

Suggested Readings:

Sr. No.	Books
1.	Banerjee, G.C. 2018. A Text Book of Animal Husbandry. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
2.	Dairy India Year Book 2001. A-25, Priyadarshini Vihar, DELHI.
3.	Hand book of Animal husbandry-Indian Council of Agricultural Research Publication, New Delhi, Third Edition, 2002
4.	Sastry, N.S.R & Thomas C.K, 2018 : Livestock Production and Management, Kalyani Publishers, India
5.	Harbans Singh & Moore, E.N., 1982: Livestock and Poultry Production, Prentice-Hall of India.

2nd year/ 4th semester
Crop Production Technology –II (*Rabi* Crops)
Paper code 11010401
Credits 2(1+1)

Theory

Unit –1

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops: cereals –wheat and barley,

Unit –2

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops:pulses-chickpea, lentil, peas,

Unit –3

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops:oilseeds-rapeseed, mustard and sunflower; sugar crops-sugarcane;

Unit –4

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of *Rabi* crops:Forage crops-berseem, lucerne and oats.

Practical

Sowing methods of wheat and sugarcane, identification of weeds in *rabiseason* 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 *rabiforage* experiments, visit to research stations of related crops.

Suggested Readings:

Sr. No.	Books
1.	Chatterjee, B.N. 1989. Forage Crop Production- Principles and Practices. Oxford and IBH . New Delhi.
2.	Chidida Singh, Prem Singh and Rajbir Singh. 2003. Modern Techniques of Raising Field Crops (2nd ed.). Oxford and IBH, New Delhi.
3.	ICAR [Indian Council of Agricultural Research].2006. Hand Book of Agriculture. ICAR, New Delhi
4.	Pal, M., Deka, J., and Rai, R.K. 1996. Fundamentals of Cereal Crop Production. Tata McGraw Hill Pub., New Delhi
5.	Prasad, R. (ed.). 1999. A Text Book of Rice Agronomy, Jain Brothers, New Delhi,

2nd year/ 4th semester
Production Technology for Ornamental Crops, MAP and Landscaping
Paper code 11010402
Credits 2(1+1)

Theory

Unit –1

Importance and scope of ornamental crops, medicinal and aromatic plants and landscaping. Principles of landscaping. Landscape uses of trees, shrubs and climbers.

Unit –2

Production technology of important cut flowers like rose, gerbera, carnation, liliium and orchids under protected conditions and gladiolus, tuberose, chrysanthemum under open conditions. Package of practices for loose flowers like marigold and jasmine under open conditions.

Unit –3

Production technology of important medicinal plants like ashwagandha, asparagus, aloe, coleus, Cinnamomum, periwinkle, isabgol and aromatic plants like mint, lemongrass, citronella, palmarosa, ocimum, rose, geranium, vetiver.

Unit –4

Processing and value addition in ornamental crops and MAPs produce.

Practical

Identification of Ornamental plants. Identification of Medicinal and Aromatic Plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Bed preparation and planting of MAP. Protected structures – care and maintenance. Intercultural operations in flowers and MAP. Harvesting and post harvest handling of cut and loose flowers. Processing of MAP. Visit to commercial flower/MAP unit.

Suggested Readings:

Sr. No.	Books
1.	Chadha, K.L.2001. Hand Book of Horticulture, ICAR, New Delhi
2.	Kirthikar.K.R. and Basu.B.D. 1993. Indian Medicinal Plants, Vol. 1-4. Lalit Mohan
3.	Kurian, A and Sankar, M.A.2007. Medicinal Plants. New India Publishing Agency, New Delhi

2nd year/ 4th semester
Renewable Energy and Green Technology
Paper code 11010403
Credits 2(1+1)

Theory

Unit –1

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

Unit –2

Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as bioenergy resource, introduction of solar energy, collection and their application.

Unit –3

Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application, introduction of wind energy and their application.

Practical

Familiarization with renewable energy gadgets. To study biogas plants, To study gasifier, To study the production process of biodiesel, To study briquetting machine, To study the production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping, solar fencing. To study solar cooker, To study solar drying system. To study solar distillation and solar pond.

Suggested Readings:

Sr. No.	Books
1.	Jeremy Shere, 2013, Renewable: The World-Changing Power of Alternative Energy, St. Martin's Press
2.	Robert Ehrlich, 2013, Renewable Energy: A First Course, CRC Press
3.	David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, 2014, Renewable Energy Systems, Pearson Publisher

2nd year/ 4th semester
Problematic Soils and their Management
Paper code 11010404
Credits 2(2+0)

Theory

Unit –1

Soil quality and health, Distribution of Waste land and problem soils in India. Their categorization based on properties.

Unit- 2

Reclamation and management of Saline and sodic soils, Acid soils, Acid Sulphate soils, Compacted soils, Flooded/ Waterlogged soils.

Unit- 3

Irrigation water – quality and standards, utilization of saline water in agriculture. Remote sensing and GIS in diagnosis and management of problem soils.

Unit- 4

Multipurpose tree species, bio remediation through MPTs of soils, land capability and classification, land suitability classification. Problematic soils under different Agro-ecosystems.

Suggested Readings:

Sr. No.	Books
1.	Adams, F., 1984. Soil Acidity and Liming. 2nd Edn, American Society of Agronomy, Madison, U.S.A.
2.	Biswas, T.D. and S.K. Mukherjee .1995. Text book of Soil Science. Tata McGraw-Hill Publishing Company Limited, New Delhi.
3.	Das, D.K. 1997. Introductory Soil Science. Kalyani Publishers,
4.	Brady, N.C. and R.R. Well. 2007. The Nature and Properties of soil. 13th edition. Dorling Kindersley (India) Pvt. Ltd., New Delhi – 110092
5.	Das.D.K, 1997. Introductory Soil Science. Kalyani Publishers, New Delhi.

2nd year/ 4th semester
Production Technology of Fruit and Plantation Crops
Paper code 11010405
Credits 2(1+1)

Theory

Unit –1

Importance and scope of fruit and plantation crop industry in India; Importance of rootstocks;

Unit –2

Production technologies for the cultivation of tropical and sub-tropical fruits- mango, banana, citrus, grape, guava, litchi, papaya, sapota.

Unit –3

Production technologies for the cultivation of temperate fruits: apple, pear, peach, walnut, almond, strawberry and; minor fruits- date, *ber*, pineapple, pomegranate, jackfruit.

Unit –4

Production technologies for the cultivation of plantation crops-coconut, arecanut, cashew, tea, cocoa coffee & rubber.

Practical

Seed propagation. Scarification and stratification of seeds. Propagation methods for fruit and plantation crops. Description and identification of fruits. Preparation of plant bio regulators and their uses, Important pests, diseases and physiological disorders of above fruit and plantation crops, Visit to commercial orchards.

Suggested Readings:

Sr. No.	Books
1.	Amar Singh, 1986. Fruit Physiology and Production. Kalyani Publishers, Delhi.
2.	Bose, T.K, Mitra, S.K. and Sanyal, D. 2002. Fruits: Tropical and Subtropical. Vol. I and II, Nayaprakash Publications, Calcutta.
3.	Chadha, K.L.2001. Hand Book of Horticulture, ICAR, New Delhi.
4.	CPCRI, 2003. Coffee Guide, Central Coffee Research Institute, Coffee Board, Chickamangalur, Karnataka.
5.	Kumar.N, Abdul Khader.J.B.M. Rangaswami.P. and Irulappan., 1993. Introduction to Spices – Plantation Crops, Medicinal and Aromatic Plants, Rajalekshmi Pub, Nagercoil.

2nd year/ 4th semester
Principles of Seed Technology
Paper code 11010406
Credits 3(1+2)

Theory

Unit –1

Seed and seed technology: introduction, definition and importance. Deterioration causes of crop varieties and their control; Maintenance of genetic purity during seed production, seed quality; Definition, Characters of good quality seed, different classes of seed.

Unit –2

Foundation and certified seed production of important cereals, pulses, oilseeds, fodder and vegetables. Seed certification, phases and procedure for seed certification, field inspection. Seed Act and Seed Act enforcement. Duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983. Varietal Identification through Grow Out Test and Electrophoresis - Molecular and Biochemical test.

Unit –3

Detection of genetically modified crops, Transgene contamination in non-GM crops, and organic seed production. Seed drying, processing and their steps, seed testing for quality assessment, seed treatment, its importance, method of application and seed packing. Seed storage; general principles, stages and factors affecting seed longevity during storage. Measures for pest and disease control during storage.

Unit –4

Seed Processing plant and Seed marketing: structure and organization, sales generation activities, promotional media. Factors affecting seed marketing, Role of WTO and OECD in seed marketing. Private and public sectors and their production and marketing strategies.

Practical

Seed production in major cereals: Wheat, Rice, Maize, Sorghum, Bajra and Ragi. Seed production in major pulses: Urd, Mung, Pigeon pea, Lentil, Gram, Field bean, pea. Seed production in major oilseeds: Soybean, Sunflower, Rapeseed, Groundnut and Mustard. Seed production in important vegetable crops. Seed sampling and testing: Physical purity, germination, viability, etc. Seed and seedling vigour test. Genetic purity test: Grow out test and electrophoresis. Visit to seed production farms, seed testing laboratories and seed processing plant.

Suggested Readings:

Sr. No.	Books
1.	Agrawal, P.K. 1994. Principles of Seed Technology, Kalyani Publishers, Ludhiana
2.	Agrawal, R.L. 1990. Seed Technology Kalyani Publishers, Ludhiana
3.	Agrawal, P.K. and N. Dadlani 1995. Techniques in Seed Science and Technology
4.	Neal C. Stoskopf, Dwight T. Tomes and B.R. Christie. 2006. Plant Breeding Theory and Practice. Scientific Publishers (India), Jodhpur.
5.	Dahiya, B.S.; Rai, K.N. 1995 Seed Technology, Kalyani Publishers, Ludhiana

2nd year/ 4th semester
Farming System & Sustainable Agriculture
Paper code 11010407
Credits 1(1+0)

Theory

Unit –1

Problems and prospects of present day agriculture. Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance,

Unit –2

Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability,

Unit –3

Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques

Unit –4

Resource cycling and flow of energy in different farming system, farming system and environment, Wasteland and their development, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.

Suggested Readings:

Sr. No.	Books
1.	Dahama,A.K. 2007. Organic Farming for Sustainable Agriculture. 2nd Edn. Published by AGROBIOS (India) Jodhpur
2.	Gupta, P.K. 2006. Vermi-composting for Sustainable Agriculture. Published by AGROBIOS (India) Jodhpur
3.	Sharma, A.K. 2006. A Hand Book of Organic Farming. Published by AGROBIOS (India) Jodhpur
4.	Sharma, A.K. 2005. Biofertilizers for Sustainable Agriculture. Published by AGROBIOS (India) Jodhpur

2nd year/ 4th semester
Agricultural Marketing Trade & Prices
Paper code 11010408
Credits 3(2+1)

Theory

Unit –1

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.

Unit –2

Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; product life cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits & demerits; marketing process and functions:

Unit –3

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 labeling (Agmark); 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

Unit –4

Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP & DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation & hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR.

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 overtime 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:

Sr. No.	Books
1.	Acharya, S.S., Agarwal, N.L. 1987. Agricultural Marketing in India. Oxford and IBH, New Delhi.
2.	Acharya, S.S., Agarwal, N.L. 1994. Agricultural Prices and Policy. Oxford and IBH, New Delhi.
3.	Philip, K. 2004. Principles of Marketing. Prentice Hall, New Delhi.

2nd year/ 4th semester
Introductory Agro-meteorology & Climate Change
Paper code 11010409
Credits 2(1+1)

Theory

Unit –1

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;

Unit –2

Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth;

Unit –3

Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; 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, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave.

Unit –4

Agriculture and weather relations; Modifications of crop microclimate, climatic normals for crop and livestock production. Introduction to remote sensing and GIS. 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 Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and longwave 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 wind rose. Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

Suggested Readings:

Sr. No.	Books
1.	Khadekar, S.R. 2001. Meteorology. Agromet publishers, Nagpur
2.	Prasada Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Second Edition. Keral Agricultural University, Thrissur.
3.	Varshneya, M.C. and Balakrishna Pillai, B. 2003. Textbook of Agricultural Meteorology. ICAR, New Delhi.
4.	Dash, S.K. and Rathore, L.S., 2011. Challenges and Opportunities in Agrometeorology

3rd year/ 5th semester
Principles of Integrated Pest and Disease Management
Paper code 11010501
Credits 3(2+1)

Theory

Unit –1

Categories of insect pests and diseases, IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of insect pests, diseases and pest risk analysis. Methods of detection and diagnosis of insect pest and diseases. Calculation and dynamics of economic injury level and importance of Economic threshold level.

Unit –2

Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment.

Unit –3

Introduction to conventional pesticides for disease management. Survey surveillance and forecasting of diseases. Development and validation of IPM module.

Unit –4

Implementation and impact of IPM (IPM module for Insect pest and disease). Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes. Case histories of important IPM programmes

Practical

Methods of diagnosis and detection of various insect pests, and plant diseases, Methods of insect pests and plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents, different predators and natural enemies. Mass multiplication of Trichoderma, Pseudomonas, Trichogramma, NPV etc. Identification and nature of damage of important insect pests and diseases and their management. Crop (agroecosystem) dynamics of a selected insect pest and diseases. Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by insect, pest and diseases. Awareness campaign at farmers' fields..

Suggested Readings:

Sr. No.	Books
1.	Agrios, G.N. 2003. Plant Pathology Academy Press. New York.
2.	Dasgupta, M.K. 1998. Principles of Plant Pathology. Allied Publishers Pvt. Ltd. Bangalore
3.	Maloy. O.C. 1993. Plant Disease Control. Principles and Practice. John Wiley and Sons.Inc. New York
4.	Nene, Y.L. and Thapliyal, P.N. 1998. Fungicides in Plant Disease Control. Oxford and IBH New Delhi
5.	Singh. R.S 2002. Introduction to Principles of Plant Pathology. Oxford and IBH Publishing, New Delhi

3rd year/ 5th semester
Manures, Fertilizers and Soil Fertility Management
Paper code 11010502
Credits 3(2+1)

Theory

Unit –1

Introduction and importance of organic manures, properties and methods of preparation of bulky and concentrated manures. Green/leaf manuring. Fertilizer recommendation approaches. Integrated nutrient management.

Unit –2

Chemical fertilizers and types: classification, composition and properties of major nitrogenous, phosphatic and potassic fertilizers, secondary & micronutrient fertilizers, Complex fertilizers, nano-fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order.

Unit –3

Soil fertility and productivity, 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 –4

Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur 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. Fertilizers Indicator plants (crop). Methods of fertilizer recommendations to crops. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions.

Practical

Introduction of analytical instruments and their principles, calibration and applications, Colorimetry and flame photometry. Estimation of soil organic carbon, Estimation of alkaline hydrolysable N in soils. Estimation of soil extractable P in soils. Estimation of exchangeable K; Ca and Mg in soils. Estimation of soil extractable S in soils. Estimation of DTPA extractable Zn in soils. Estimation of N in plants. Estimation of P in plants. Estimation of K in plants. Estimation of S in plants.

Suggested Readings:

Sr. No.	Books
1.	Burges, A, and Raw, F. 1967. Soil Biology. Acad. Press, New York
2.	Donahu, L. R., Miller, W. R. and Shickuluna, 1977. Soils. Prentice Hall of India Pvt. Ltd., New Delhi
3.	Mengel, K.J. and Kirkby, A. 1978. Principles of Plant Nutrition. International Potash Institute, Switzerland
4.	Nyle.C. Brady 1995. The Nature and Properties of Soils. 10th Edn. Printice Hall India Pvt.. Ltd. New Delhi
5.	Raymond W Miller and Roy L. Donahue. 1992. Soils and Introduction to Soils and Plant Growth. 6th edn. Printice Hall India pvt. Ltd. New Delhi

3rd year/ 5th semester
Pests of Crops and Stored Grain and their Management
Paper code 11010503
Credits 3(2+1)

Theory

Unit –1

General account on nature and type of damage by different arthropods pests. Classification, host range, distribution, biology and bionomics, nature of damage, and management of major insect pests and non insect pests of field crop, vegetable, fruit, and plantation crops

Unit –2

Classification, host range, distribution, biology and bionomics, nature of damage, and management of major insect pests and non insect pests of ornamental, spices and condiment crops.

Unit –3

Insect pests, mites, rodents, birds and microorganisms associated with stored grain and their management. Storage structure and methods of grain storage.

Unit –4

Factors affecting losses of stored grain and role of physical, biological, mechanical and chemical factors in deterioration of grain.

Practical

Identification of various insect pests and their nature of damage on Field, Vegetable, Fruit, Plantation, spice crops & condiments. Identification and study of life cycle and seasonal history. Pesticide application techniques. Determination of insect infestation by different methods. Assessment of losses due to insects. Calculations on the doses of insecticides application technique. Identification of insect pests and Mites, rodents, birds associated with stored grains and their management, assessment of losses due to insect pests. Determination of moisture content of grain. Methods of grain sampling under storage condition. Visit to Indian Storage Management and Research Institute, Hapur Visit to nearby silos/ FCI godowns.

Suggested Readings:

Sr. No.	Books
1.	Atwal, A. S. 1991. Agricultural Pests of India and South – East Asia. Kalyani Publishers, New Delhi. 529p.
2.	David, B. V. 2001. Elements of Economic Entomology. Popular Book Depot, Madras, 536p.
3.	Ghosh, S. K. Dubey, S. L. 2003. Integrated Management of Stored Grain Pests. International Book Distributing Company. 263p.
4.	Nair, M. R. G. K. 1986. Insects and Mites of Crops in India. Indian Council of Agricultural Research, New Delhi. 267p.
5.	Pradhan, S. 1983. Agricultural Entomology and Pest Control. Indian Council of Agricultural Research, New Delhi. 267p.

3rd year/ 5th semester
Diseases of Field and Horticultural Crops and their Management- I
Paper code 11010504
Credits 3(2+1)

Theory

Unit –1

Symptoms, etiology, disease cycle and management of major diseases of Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra (pearlmillet): downy mildew, powdery mildew and ergot; Groundnut: Tikka and wilt.

Unit –2

Symptoms, etiology, disease cycle and management of major diseases of Soybean: *Rhizoctonia* blight, bacterial spot, and mosaic; Pigeonpea: *Phytophthora* blight, wilt and sterility mosaic; Finger millet: Blast and leaf spot; black & greengram: *Cercospora* leaf spot and anthracnose, web blight and yellow mosaic.

Unit –3

Symptoms, etiology, disease cycle and management of major diseases of Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, *Sigatoka* and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight; Cruciferous vegetables: *Alternaria* leaf spot and black rot; Brinjal: *Phomopsis* blight and fruit rot and *Sclerotinia* blight.

Unit –4

Symptoms, etiology, disease cycle and management of major diseases of Tomato: damping off, wilt, early and late blight, leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: *Phytophthora* blight; Tea: blister blight; Coffee: rust

Practical

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; Note: Students should submit 50 pressed and well mounted specimens.

Suggested Readings:

Sr. No.	Books
1.	Singh, R.S 2001. Plant Disease Management, Oxford and IBH Publishing Co N. Delhi.
2.	Mehrotra. R. S. Plant Pathology. TATA Mechgrow Hill Pub. Co. N. Delhi.
3.	Ramakrishnan, T. S. 1971. Diseases of Millets. ICAR.
4.	Sharma, P. D. 2001. Plant Pathology, Rastogi Publications, Shivaji Road, Meerut.
5.	Singh, R. S. 1995. Diseases of Vegetables Crops. Oxford and IBH Publishing Co.

3rd year/ 5th semester
Crop Improvement-I (Kharif Crops)
Paper code 11010505
Credits 2(1+1)

Theory

Unit –1

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fibers; fodders and cash crops; vegetable and horticultural crops.

Unit –2

Plant genetic resources, its utilization and conservation, study of genetics of qualitative and quantitative characters.

Unit –3

Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stresstolerance and quality (physical, chemical, nutritional).

Unit –4

Hybrid seed production technology in Maize, Rice, Sorghum, Pearl millet and Pigeonpea, etc. Ideotype concept and climate resilient crop varieties for future.

Practical

Floral biology, emasculation and hybridization techniques in different crop species; viz., Rice, Jute, Maize, Sorghum, Pearl millet, Ragi, Pigeonpea, Urd bean, Mungbean, Soybean, Groundnut, Sesame, Caster, Cotton, Cowpea, Tobacco, Brinjal, Okra and Cucurbitaceous crops. Maintenance breeding of different *Kharif* crops. Study of field techniques for seed production and hybrid seeds 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 plots of different field crops.

Suggested Readings:

S. No.	Books
1.	Strickberger, M.W. 1996. Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi
2.	B.D.Singh 2015 Plant Breeding. Principles & Methods. Kalyani Publishers.10 th Edition.

3rd year/ 5th semester
Entrepreneurship Development and Business Communication
Paper code 11010506
Credits 2(1+1)

Theory

Unit –1

Concept of Entrepreneur, Entrepreneurship Development, Characteristics of entrepreneurs;SWOT Analysis & achievement motivation, Government policy and programs and institutions for entrepreneurship development

Unit –2

Impact of economic reforms on Agribusiness/ Agri-enterprises,Entrepreneurial Development Process; Business Leadership Skills.

Unit –3

Developing organizational skill (controlling, supervising, problem solving, monitoring & evaluation), Developing Managerial skills, Business Leadership Skills (Communication, direction and motivation Skills), Problem solving skill, Supply chain management and Total quality management.

Unit –4

Project Planning Formulation and report preparation; Financing of enterprise, Opportunities for agri-entrepreneurship and rural enterprise.

Practical

Assessing entrepreneurial traits, problem solving skills, managerial skills and achievement motivation, exercise in creativity, time audit through planning, monitoring and supervision, identification and selection of business idea, preparation of business plan and proposal writing, visit to entrepreneurship development institute and entrepreneurs.

Suggested Readings:

Sr. No.	Books
1.	Downey, W.D., Troche, J.K. 1981. Agribusiness Management. Mc Graw Hill Inc., New Delhi
2.	Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins University Press, Baltimore
3.	Alagumani, T., Chinnaiyan, P., Elangovan, S. 1998. Agricultural Management. Publishers K9 International, Madurai.
4.	Philip, K. 2004. Marketing Management. Prentice Hall, New Delhi.

3rd year/ 5th semester
Geoinformatics and Nano-technology and Precision Farming
Paper code 11010507
Credits 2(1+1)

Theory

Unit –1

Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geoinformatics- definition, concepts, tool and techniques; their use in Precision Agriculture.

Unit –2

Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Basic concepts of remote sensing and GIS; Global positioning system (GPS), components and its functions.

Unit –3

Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

Unit –4

Land use planning: concept, techniques and factors governing present land use; land evaluation methods and soil suitability evaluation for different crops; land capability classification and constraints in application.

Practical

Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Use of aerial photographs, RS imagery, toposheets and other maps; ground truth study using GPS and visual markings; supervised and unsupervised classification of digital image; Fertilizers recommendations based of VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming

Suggested Readings:

Sr. No.	Books
1.	John V. S. (2005). Precision Agriculture.
2.	Pedersen, S. M and Martin, K. (2017). Precision Agriculture: Technology and Economic Perspectives.
3.	Srinivasan, A. (2006). Handbook of Precision Agriculture: Principles and Applications
4.	Rattan Lal, B.A. Stewar (2015). Soil-Specific Farming: Precision Agriculture
5.	National Academy Press, Washington, D.C. (1997). Precision Agriculture in the 21st Century: Geospatial and Information Technologies. National Academies

3rd year/ 5th semester
Practical Crop Production – I (Kharif crops)
Paper code 11010508
Credits 2(0+2)

Practical

Crop planning, raising field crops in multiple cropping systems; field preparation, seed treatment, nursery raising, sowing, nutrient management, water management, weed management and management of insect pest and diseases of crops; harvesting, threshing, drying, winnowing, storage and marketing of produce; The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students of 8-10 students.

3rd year/ 5th semester
Intellectual Property Rights
Paper code 11010509
Credits 1(1+0)

Theory

Unit –1

Introduction and meaning of intellectual property, brief introduction to GATT, WTO, TRIPs and WIPO, Treaties for IPR protection: Madrid protocol, Berne Convention, Budapest treaty, etc.

Unit –2

Types of Intellectual Property and legislations covering IPR in India:-Patents, Copyrights Trademark, Industrial design, Geographical indications, Integrated circuits, Trade secrets. Patents Act 1970 and Patent system in India, patentability, process and product patent, filing of patent, patent specification, patent claims, Patent opposition and revocation, infringement, compulsory licensing, Patent Cooperation Treaty, Patent search and patent database.

Unit –3

Origin and history including a brief introduction to UPOV for protection of plant varieties, Protection of plant varieties under UPOV and PPV&FR Act of India, Plant breeders rights, Registration of plant varieties under PPV&FR Act 2001, breeders, researcher and farmers rights.

Unit –4

Traditional knowledge-meaning and rights of TK holders. Convention on Biological Diversity, International treaty on plant genetic resources for food and agriculture (ITPGRFA). Indian Biological Diversity Act, 2002 and its salient features access and benefit sharing.

Suggested Readings:

S. No.	Books
1.	Strickberger, M.W. 1996. Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi
2.	B. D. Singh 2015 Plant Breeding. Principles & Methods. Kalyani Publishers. 10 th Edition.

3rd year/ 6th semester
Rainfed Agriculture & Watershed Management
Paper code 11010601
Credits 2(1+1)

Theory

Unit –1

Rainfed agriculture: Introduction, types, climatic and edaphic characteristics, History of rainfed agriculture and watershed in India; Problems and prospects of rainfed agriculture in India.

Unit –2

Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on physio-morphological characteristics of the plants, Crop adaptation and mitigation to drought.

Unit –3

Management strategies of rainfed crops; critical stages of life saving irrigations. Water harvesting: importance, its techniques, efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas.

Unit –4

Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, factors affecting watershed management. Study of mulches and anti-transpirants; water harvesting and moisture conservation; principles of intercropping, cropping systems/intercropping in rainfed agriculture.

Practical

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. 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. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Suggested Readings:

Sr. No.	Books
1.	Gurmel Singh, C. Venkataraman, G., Sastry, B. and Joshi, P. 1990. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co., New Delhi.
2.	Hansen, V.E., Israelsen, O.W., and Stringham, G.E. 1979. Irrigation Principles and Practices (4th ed.). John Wiley and Sons, New York
3.	IARI [Indian Agricultural Research Institute]. 1977. Water Requirement and Irrigation Management of Crops in India, IARI Monograph No.4, Water Technology Centre, IARI, New-Delhi.
4.	Lenka, D. 2001. Irrigation and Drainage. Kalyani Publishers, New-Delhi.
5.	Mal, B. C. 2002. Introduction to Soil and Water Conservation Engineering, Kalyani Publishers, New-Delhi.

3rd year/ 6th semester
Protected Cultivation and Secondary Agriculture
Paper code 11010602
Credits 2(1+1)

Theory

Unit –1

Green house technology: Introduction, Types of Green Houses, Plant response to Green house environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes.

Unit –2

Green house equipments, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, typical applications, passive solar greenhouse, hot air green house heating systems, green house drying, Cost estimation and economic analysis.

Unit –3

Important Engineering properties such as physical, thermal and aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation.

Unit –4

Drying and dehydration; moisture measurement, EMC, drying theory, various drying method, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, re-circulatory dryer and solar dryer). Material handling equipment; conveyer and elevators, their principle, working and selection.

Practical

Study of different type of green houses based on shape. Determination of the rate of air exchange in an active summer winter cooling system. Determination of drying rate of agricultural products inside green house. Study of green house equipments. Visit to various Post Harvest Laboratories. Determination of Moisture content of various grains by oven drying & infrared moisture methods. Determination of engineering properties (shape and size, bulk density and porosity of biomaterials). Determination of Moisture content of various grains by moisture meter. Field visit to seed processing plant.

Suggested Readings:

Sr. No.	Books
1.	Balraj Singh. 2005. Protected Cultivation Of Vegetable Crops, Kalyani Publishers
2.	Brahma Singh. 2015. Advances in Protected Cultivation, New India Publishing Agency.
3.	Dahiya, B.S.; Rai, K.N. 1995 Seed Technology, Kalyani Publishers, Ludhiana

3rd year/ 6th semester
Diseases of Field and Horticultural Crops and their Management-II
Paper code 11010603
Credits 3(2+1)

Theory

Unit –1

Symptoms, etiology, disease cycle and management of diseases of Field Crops: Wheat: rusts, loose smut, Karnal bunt, powdery mildew, *Alternaria* blight, and ear cockle/*molya disease*; Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and PokkahBoeng; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra :downy mildew and ergot; Groundnut: early and late leaf spots, wilt.

Unit –2

Symptoms, etiology, disease cycle and management of diseases of Sunflower: Sclerotinia stem rot and *Alternaria* blight; Mustard: *Alternaria* blight, white rust, downy mildew and Sclerotinia stem rot; chickpea: wilt, grey mould and *Ascochyta* blight; Cotton: anthracnose, vascular wilt, and black arm; Pea: downy mildew, powdery mildew and rust.

Unit –3

Symptoms, etiology, disease cycle and management of diseases of Horticultural Crops: Mango: anthracnose, malformation, bacterial blight and powdery mildew; Citrus: canker and gummosis; Grape vine: downy mildew, Powdery mildew and anthracnose; Apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl. Strawberry: leaf spot Potato: early and late blight, leaf roll, and mosaic.

Unit –4

Symptoms, etiology, disease cycle and management of diseases of Cucurbits: downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and *Stemphylium* blight; Chillies: anthracnose and fruit rot, wilt and leaf curl; Turmeric: leaf spot, Rose: dieback, powdery mildew and black leafspot. Brinjal: *Phomopsis* blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot.

Practical

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.

Note: Students should submit 50 pressed and well-mounted specimens.

Suggested Readings:

Sr. No.	Books
1.	Singh, R.S 2001. Plant Disease Management, Oxford and IBH Publishing Co. N. Delhi.
2.	Mehrotra. R. S. Plant Pathology. TATA Mechgrow Hill Pub. Co. N. Delhi.
3.	Ramakrishnan, T. S. 1971. Diseases of Millets. ICAR.
4.	Sharma, P. D. 2001. Plant Pathology, Rastogi Publications, Shivaji Road, Meerut.
5.	Singh, R. S. 1995. Diseases of Vegetables Crops. Oxford and IBH Publishing Co.

3rd year/ 6th semester
Post-harvest Management and Value Addition of Fruits and Vegetables
Paper code 11010604
Credits 2(1+1)

Theory

Unit –1

Importance of post-harvest processing of fruits and vegetables, extent and possible causes of post harvest losses

Unit –2

Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening; Respiration and factors affecting respiration rate;

Unit –3

Harvesting and field handling; Storage (ZECC, cold storage, CA, MA, and hypobaric); Value addition concept

Unit –4

Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy – Concepts and Standards; Fermented and non-fermented beverages. Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables – Concept and methods, osmotic drying. Canning- Concepts and Standards, packaging of products.

Practical

Applications of different types of packaging, containers for shelf life extension. Effect of temperature on shelf life and quality of produce. Demonstration of chilling and freezing injury in vegetables and fruits. Extraction and preservation of pulps and juices. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar and candy and tomato products, canned products. Quality evaluation of products -- physico-chemical and sensory. Visit to processing unit/ industry.

Suggested Readings:

Sr. No.	Books
1.	Wills, R. B. H. 1998. Postharvest, UNSW Press.
2.	Shewfelt, R. L. and Stanley, P. E. 1992. Post Harvest Handling: A Systems Approach, Academic Press Inc.
3.	Prusky, D. and Gullino, M. L. 2010. Postharvest Pathology, Springer.

3rd year/ 6th semester
Management of Beneficial Insects
Paper code 11010605
Credits 2(1+1)

Theory

Unit –1

Importance of beneficial Insects, pollinators and their role in cross pollinated crops, Beekeeping, bee biology, Bee pasturage, bee foraging and communication commercial methods of rearing, equipment used, seasonal management, bee enemies, Insect pests and diseases of honey bee.

Unit –2

Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management, rearing appliances of mulberry silkworm and methods of disinfection.

Unit –3

Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac-products. Identification of major parasitoids and predators commonly being used in biological control.

Unit –4

Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance.

Practical

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, beenemies and disease. Bee pasturage, bee foraging and communication. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Species of lac insect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies. Identification and techniques for mass multiplication of natural enemies.

Suggested Readings:

Sr. No.	Books
1.	David, B.V. and Kumaraswami, T. 1996 Elements of Economic Entomology. Popular Book Depot, Madras. 536 p.

3rd year/ 6th semester
Crop Improvement-II (*Rabi* crops)
Paper code 11010606
Credits 2(1+1)

Theory

Unit –1

Centers of origin, distribution of species, wild relatives in different cereals; pulses; oilseeds; fodder crops and cash crops; vegetable and horticultural crops.

Unit –2

Plant genetic resources, its utilization and conservation; study of genetics of qualitative and quantitative characters.

Unit –3

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 –4

Hybrid seed production technology of *rabi* crops. Ideotype concept and climate resilient crop varieties for future.

Practical

Floral biology, emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rajma, Horse gram, Rapeseed Mustard, Sunflower, Safflower, Potato, Berseem. Sugarcane, Tomato, Chilli and Onion. Study of field techniques for seed production and hybrid seeds production in *Rabi* crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, study of donor parents for different characters; Visit to seed production plots; Visit to AICRP plots of different field crops

Suggested Readings:

S. No.	Books
3.	Strickberger, M.W. 1996. Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi
4.	B.D.Singh, 2015, Plant Breeding. Principles & Methods, 10 th edition, Kalyani Publishers, New Delhi.

3rd year/ 6th semester
Practical Crop Production –II (Rabi crops)
Paper code 11010607
Credits 2(0+2)

Practical

Crop planning, raising field crops in multiple cropping systems; field preparation, seed treatment, sowing, nursery raising, nutrient management, water management, weed management and management of insect pests and diseases of crops; harvesting, threshing, drying, winnowing, storage and marketing of produce; The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students.

3rd year/ 6th semester
Principles of Organic Farming
Paper code 11010608
Credits 2(1+1)

Theory

Unit –1

Organic farming, principles, relevance in present context and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.

Unit –2

Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; vermi-composting, green manuring, recycling of organic residues, bio-fertilizers.

Unit –3

Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production

Unit –4

Operational structure of NPOP; Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling.

Suggested Readings:

Sr. No.	Books
1.	Wishwall, R. The Organic Farmer's Business Handbook
2.	Sapna E. Thottathi. India's Organic Farming Revolution: What It Means for Our Global Food System
3.	Tripathy, P. and Thapa, U. Organic Farming In India
4.	Balasubramanian, R., Balakrishnan, K. and Sivasubr, K. Principles & Practices of Organic Farming

3rd year/ 6th semester
Farm Management, Production & Resource Economics
Paper code 11010609
Credits 2(1+1)

Theory

Unit –1

Meaning and concept of farm management, objectives and relationship with other sciences. Meaning and definition of farms, its types and characteristics, factor determining types and size of farms. Principles of farm management: concept of production function and its type, use of production function in decision-making on a farm, factor-product, factor-factor and product-product relationship, law of equi-marginal/or principles of opportunity cost and law of comparative advantage.

Unit –2

Meaning and concept of cost, types of costs and their interrelationship, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income. Farm business analysis: meaning and concept of farm income and profitability, technical and economic efficiency measures in crop and livestock enterprises.

Unit –3

Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain on farm, farm inventory, balance sheet, profit and loss accounts. Meaning and importance of farm planning and budgeting, partial and complete budgeting, steps in farm planning and budgeting-linear programming, appraisal of farm resources, selection of crops and livestock's enterprises.

Unit –4

Concept of risk and uncertainty occurs in agriculture production, nature and sources of risks and its management strategies, Crop/livestock/machinery insurance– weather based crop insurance, features, determinants of compensation. Concepts of resource economics. Differences between NRE and agricultural economics, unique properties of natural resources. Positive and negative externalities in agriculture, Inefficiency and welfare loss, solutions, Important issues in economics and management of common property resources of land, water, pasture and forest resources etc.

Practical

Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Application of equi-marginal returns/opportunity cost principle in allocation of farm resources. Determination of most profitable level of inputs uses in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crop and livestock enterprises. Preparation of farm plan and budget, farm records and accounts and profit & loss accounts. Collection and analysis of data on various resources in India.

Suggested Readings:

Sr. No.	Books
1.	S. Subha Reddy, P. Raghu Ram, V. Neela Kanta Sasgtri, I. Bhavani Devi. Agricultural Economics.
2.	Agrawal, A. N. Indian Agricultural Problems, Progress and Prospects. Vikas Publishing House Pvt. Ltd.
3.	S S. Johl and C.V. Moore. Essentials of Farm Management.
4.	E.O. Heedy and J.L. Dillon. Agricultural Production Functions. Kalyani Publishers.

3rd year/ 6th semester
Principles of Food Science and Nutrition
Paper code 11010610
Credits 2(2+0)

Theory

Unit –1

Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.)

Unit –2

Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bioactives, important reactions); Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, production of fermented foods)

Unit –3

Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.)

Unit –4

Food and nutrition, Malnutrition (over and undernutrition), nutritional disorders; Energy metabolism (carbohydrate, fat, proteins); Balanced/modified diets, Menu planning, New trends in food science and nutrition.

Suggested Readings:

Sr. No.	Books
1.	Janet D. Ward and Larry Ward. 2015. Principles of Food Science
2.	John Wiley & Sons. 2017. Food Science and Technology
3.	Potter, Norman N.; Hotchkiss, Joseph H. 1998. Food Science. Food science texts series (5th ed.). Springer.

4th Year/7th Semester
Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE & AIA)

Credits: 20 (0+20)

Rural Agricultural Work Experience and Agro-industrial Attachment (RAWE &AIA)				
No.	Activities	Code	No. of weeks	Credits
1.	General orientation & on campus training by different faculties	11010701	1	14
2.	Village attachment		8	
3.	Unit attachment in Univ./ College. KVK/ Research Station attachment		5	
4.	Plant clinic	11010702	2	2
5.	Agro-industrial attachment	11010703	3	4
6.	Project report preparation, presentation and evaluation		1	
Total weeks for RAWE & AIA			20	20

- Agro- Industrial Attachment: The students would be attached with the agro-industries for a period of 3 weeks to get an experience of the industrial environment and working.

RAWE & AIA Component-I

Village Attachment Training Programme

Sr. No.	Activity	Duration
1.	Orientation and Survey of Village	1 week
2.	Agronomical Interventions	1 week
3.	Plant Protection Interventions	1 week
4.	Soil Improvement Interventions (Soil sampling and testing)	1 week
5.	Fruit and Vegetable Production Interventions	1 week
6.	Food Processing and Storage Interventions	1 week
7.	Animal Production Interventions	1 week
8.	Extension and Transfer of Technology activities	1 week

RAWE & AIA Component –II

Agro Industrial Attachment

- Students shall be placed in Agro-and Cottage industries and Commodities Boards for 03 weeks.
- Industries include Seed/Sapling production, Pesticides-insecticides, Post harvest-processing value addition, Agri-finance institutions, etc.

Activities and Tasks during Agro-Industrial Attachment Programme

- Acquaintance with industry and staff
- Study of structure, functioning, objective and mandates of the industry
- Study of various processing units and hands-on trainings under supervision of industry staff
- Ethics of industry
- Employment generated by the industry
- Contribution of the industry promoting environment
- Learning business network including outlets of the industry
- Skill development in all crucial tasks of the industry
- Documentation of the activities and task performed by the students
- Performance evaluation, appraisal and ranking of students

4th Year/8th Semester
Modules for Skill Development and Entrepreneurship

A student has to register 20 credits opting for two modules of (0+10) credits each (total 20 credits) from the package of modules.

Paper Code	Title of the module	Credits
11010801	Production Technology for Bioagents and Biofertilizers	0+10
11010802	Seed Production and Technology	0+10
11010803	Mushroom Cultivation Technology	0+10
11010804	Soil, Plant, Water and Seed Testing	0+10
11010805	Commercial Beekeeping	0+10
11010806	Poultry Production Technology	0+10
11010807	Commercial Horticulture	0+10
11010808	Floriculture and Landscaping	0+10
11010809	Food Processing	0+10
11010810	Agriculture Waste Management	0+10
11010811	Organic Production Technology	0+10
11010812	Commercial Sericulture	0+10

NOTE: In addition to above ELP modules other important modules may be given to the students by SAUs.

Evaluation of Experiential Learning Programme (ELP):

Sr. No.	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation	10
3.	Regularity	10
4.	Monthly Assessment	10
5.	Output Delivery	10
6.	Technical Skill Development	10
7.	Entrepreneurship Skills	10
8.	Business Networking Skills	10
9.	Report Writing Skills	10
10.	Final Presentation	10
	Total	100

ANNEXURE- I

ELECTIVE COURSES **Agri-business Management** **Paper code 11010001**

Credits: 3 (2+1)

Theory

Unit-1

Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Importance of agribusiness in the Indian economy and New Agricultural Policy. Distinctive features of Agribusiness Management: Importance and needs of agro-based industries, Classification of industries and types of agro based industries. Institutional arrangement, procedures to set up agro based industries. Constraints in establishing agro-based industries.

Unit-2

Agri-value chain: Understanding primary and support activities and their linkages. Business environment: PEST & SWOT analysis. Management functions: Roles & activities, Organization culture. Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, policies procedures, rules, programs and budget.

Unit-3

Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital Management and Financial management of Agribusiness. Financial statements and their importance. Marketing Management: Segmentation, targeting & positioning.

Unit-4

Marketing mix and marketing strategies. Consumer behaviour analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management definition, project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

Practical

Study of agri-input markets: Seed, fertilizers, pesticides. Study of output markets: grains, fruits, vegetables, flowers. Study of product markets, retails trade commodity trading, and value added products. Study of financing institutions- Cooperative, Commercial banks, RRBs, Agribusiness Finance Limited, NABARD. Preparations of projects and Feasibility reports for agribusiness entrepreneur. Appraisal/evaluation techniques of identifying viable project- Non-discounting techniques. Case study of agro-based industries. Trend and growth rate of prices of agricultural commodities. Net present worth technique for selection of viable project. Internal rate of return.

Suggested Readings:

Sr. No.	Books
1.	Subba rao reddy, S. and P. Raghav Rao. Agriculture finance and management. Oxford and IBH Publication company Ltd. New Delhi
2.	Dwivedi, D.N. Managerial Economics. Vikas Publishing House. New Delhi
3.	Dhingra, I.C, Indian economic problems. Sultan chand and sons, New Delhi

Agrochemicals
Paper code 11010002
Credits: 3 (2+1)

Theory

Unit-1

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-2

Herbicides-Major classes, properties and important herbicides. Fate of herbicides. Fungicides - Classification – Inorganic fungicides - characteristics, preparation and use of sulfur and copper, Mode of action-Bordeaux mixture and copper oxychloride. Organic fungicides- Mode of action- Dithiocarbamates-characteristics, preparation and use of Zineb and maneb.

Unit-3

Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim, characteristics and use. Introduction and classification of 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 & plant. IGRs Biopesticides, Reduced risk insecticides, Botanicals, plant and animal systemic insecticides their characteristics and uses.

Unit-4

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. Fertilizer control order. Fertilizer logistics and marketing. Plant bio-pesticides for ecological agriculture, Bio-insect repellent.

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about various pesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available in market. Estimation of nitrogen in Urea. Estimation of 120 Report of the ICAR Fifth Deans' Committee water soluble P₂O₅ and citrate soluble P₂O₅ in single super phosphate. Estimation of potassium in Murreite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide. Determination of thiram. Determination of ziram content.

Commercial Plant Breeding

Paper code 11010003

Credits: 3(1+2)

Theory

Unit- 1

Types of crops and modes of plant reproduction. Line development and maintenance breeding in self and cross pollinated crops (A/B/R and two line system) for development of hybrids and seed production. Genetic purity test of commercial hybrids.

Unit-2

Advances in hybrid seed production of maize, rice, sorghum, pearl millet, castor, sunflower, cotton pigeon pea, Brassica etc. Quality seed production of vegetable crops under open and protected environment.

Unit-3

Alternative strategies for the development of the line and cultivars: haploid inducer, tissue culture techniques and biotechnological tools. IPR issues in commercial plant breeding: DUS testing and registration of varieties under PPV & FR Act.

Unit-4

Variety testing, release and notification systems in India. Principles and techniques of seed production, types of seeds, quality testing in self and cross pollinated crops.

Practical

Floral biology in self and cross pollinated species, selfing and crossing techniques. Techniques of seed production in self and cross pollinated crops using A/B/R and two line system. Learning techniques in hybrid seed production using male-sterility in field crops. Understanding the difficulties in hybrid seed production, Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing viz., grading and packaging. Visit to public private seed production and processing plants.

Landscaping
Paper code 11010004
Credits: 3(2+1)

Theory

Unit-1

Importance and scope of landscaping. Principles of landscaping, garden styles and types, terrace gardening, vertical gardening, garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features etc. gardens for special purposes.

Unit-2

Trees: selection, propagation, planting schemes, canopy management, shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climber and creepers: importance, selection, propagation, planting

Unit-3

Annuals: selection, propagation, planting scheme, Other garden plants: palms, ferns, grasses and cacti succulents. Pot plants: selection, arrangement, management. Bio-aesthetic planning: definition, need, planning.

Unit-4

Landscaping of urban and rural areas, Peri-urban landscaping, Landscaping of schools, public places like bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions. Bonsai: principles and management, lawn: establishment and maintenance. CAD application.

Practical

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals, care and maintenance of plants, potting and repotting, identification of tools and implements used in landscape design, training and pruning of plants for special effects, lawn establishment and maintenance, layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Use of computer software, visit to important gardens/parks/institutes.

Food Safety and Standards

Paper code 11010005

Credits: 3(2+1)

Theory

Unit-1

Food Safety – Definition, Importance, Scope and Factors affecting Food Safety. Hazards and Risks, Types of hazards - Biological, Chemical, Physical hazards. Management of hazards - Need. Control of parameters. Temperature control.

Unit-2

Food storage. Product design. Hygiene and Sanitation in Food Service Establishments- Introduction. Sources of contamination and their control. Waste Disposal. Pest and Rodent Control. Personnel Hygiene. Food Safety Measures. Food Safety Management Tools- Basic concepts. PRPs, GHPs, GMPs, SSOPs etc. HACCP. ISO series.

Unit-3

TQM- concept and need for quality, components of TQM, Kaizen. Risk Analysis. Accreditation and Auditing, Water Analysis, Surface Sanitation and Personal Hygiene. Food laws and Standards- Indian Food Regulatory Regime, FSSAI. Global Scenario CAC. Other laws and standards related to food.

Unit-4

Recent concerns- New and Emerging Pathogens. Packaging, Product labeling and Nutritional labeling. Genetically modified foods\ transgenics. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

Practical

Water quality analysis physico-chemical and microbiological. Preparation of different types of media. Microbiological Examination of different food samples. Assessment of surface sanitation by swab/rinse method. Assessment of personal hygiene. Biochemical tests for identification of bacteria. Scheme for the detection of food borne pathogens. Preparation of plans for Implementation of FSMS - HACCP, ISO: 22000.

Biopesticides & Biofertilizers

Paper code 11010006

Credits: 3(2+1)

Theory

History and concept of biopesticides. Importance, scope and potential of biopesticide. Definitions, concepts and classification of biopesticides viz. pathogen, botanical pesticides, and biorationales. Botanicals and their uses. Mass production technology of bio-pesticides. Virulence, pathogenicity and symptoms of entomopathogenic pathogens and nematodes. Methods of application of biopesticides. Methods of quality control and Techniques of biopesticides. Impediments and limitation in production and use of biopesticide. Biofertilizers - Introduction, status and scope. Structure and characteristic features of bacterial biofertilizers- *Azospirillum*, *Azotobacter*, *Bacillus*, *Pseudomonas*, *Rhizobium* and *Frankia*; Cyanobacterial biofertilizers- *Anabaena*, *Nostoc*, *Hapalosiphon* and fungal biofertilizers- AM mycorrhiza and ectomycorrhiza. Nitrogen fixation -Free living and symbiotic nitrogen fixation. Mechanism of phosphate solubilization and phosphate mobilization, K solubilization. Production Report of the ICAR Fifth Deans' Committee technology: Strain selection, sterilization, growth and fermentation, mass production of carrier based and liquid biofertilizers. FCO specifications and quality control of biofertilizers. Application technology for seeds, seedlings, tubers, sets etc. Biofertilizers -Storage, shelf life, quality control and marketing. Factors influencing the efficacy of biofertilizers.

Practical

Isolation and purification of important biopesticides: *Trichoderma*, *Pseudomonas*, *Bacillus*, *Metarhizium* etc. and its production. Identification of important botanicals. Visit to biopesticide laboratory in nearby area. Field visit to explore naturally infected cadavers. Identification of entomopathogenic entities in field condition. Quality control of biopesticides. Isolation and purification of *Azospirillum*, *Azotobacter*, *Rhizobium*, P-solubilizers and cyanobacteria. Mass multiplication and inoculum production of biofertilizers. Isolation of AM fungi -Wet sieving method and sucrose gradient method. Mass production of AM inoculants.

Protected Cultivation

Paper code 11010007

Credits: 3(2+1)

Theory

Protected cultivation- importance and scope, Status of protected cultivation in India and World types of protected structure based on site and climate. Cladding material involved in greenhouse/ poly house. Greenhouse design, environment control, artificial lights, Automation. Soil preparation and management, Substrate management. Types of benches and containers. Irrigation and fertigation management. Propagation and production of quality planting material of horticultural crops. Greenhouse cultivation of important horticultural crops – rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lily, tulip, tomato, bell pepper, cucumber, strawberry, pot plants, etc. 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 pro-trays 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.

Micro propagation Technologies

Paper code 11010008

Credits: 3(1+2)

Theory

Introduction, History, Advantages and limitations; Types of cultures (seed, embryo, organ, callus, cell), Stages of micropropagation, Axillary bud proliferation (Shoot tip and meristem culture, bud culture), Organogenesis (callus and direct organ formation), Somatic embryogenesis, cell suspension cultures, Production of secondary metabolites, Somaclonal variation, Cryopreservation

Practical

Identification and use of equipments in tissue culture Laboratory, Nutrition media composition, sterilization techniques for media, containers and small instruments, sterilization techniques for Report of the ICAR Fifth Deans' Committee explants, Preparation of stocks and working solution, Preparation of working medium, Culturing of explants: Seeds, shoot tip and single node, Callus induction, Induction of somatic embryos regeneration of whole plants from different explants, Hardening procedures.

Hi-tech. Horticulture

Paper code 11010009

Credits: 3(2+1)

Theory

Introduction & importance; Nursery management and mechanization; micro propagation of horticultural crops; Modern field preparation and planting methods, Protected cultivation: advantages, controlled conditions, method and techniques, Micro irrigation systems and its components; EC, pH based fertilizer scheduling, canopy management, high density orcharding, Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate applicator (VRA), application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Practical

Types of polyhouses and shade net houses, Intercultural operations, tools and equipment identification and application, Micro propagation, Nursery-protrays, micro-irrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

Weed Management

Paper code 11010010

Credits: 3(2+1)

Theory

Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds. Herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use. Introduction to mode of action of herbicides and selectivity. Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture. Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agrochemicals and their application. Integration of herbicides with non chemical methods of weed management. Herbicide Resistance and its management.

Practical

Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds. Study of herbicide formulations and mixtures. Herbicide and agrochemicals study. Shift of weed flora study in long term experiments. Methods of herbicide application, spraying equipments. Calculations of herbicide doses and weed control efficiency and weed index.

System Simulation and Agro advisory

Paper code 11010011

Credits: 3(2+1)

Theory

System Approach for representing soil-plant-atmospheric continuum, system boundaries, Crop models, concepts & techniques, types of crop models, data requirements, relational diagrams. 124 Report of the ICAR Fifth Deans' Committee Evaluation of crop responses to weather elements; Elementary crop growth models; calibration, validation, verification and sensitivity analysis. Potential and achievable crop production- concept and modelling techniques for their estimation. Crop production in moisture and nutrient limited conditions; components of soil water and nutrients balance. Weather forecasting, types, methods, tools & techniques, forecast verification; Value added weather forecast, ITK for weather forecast and its validity; Crop-Weather Calendars; Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro-advisory and its effective dissemination.

Practical

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential & achievable production; yield forecasting, insect & disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro advisory.

Agricultural Journalism

Paper code 11010012

Credits: 3(2+1)

Theory

Agricultural Journalism: The nature and scope of agricultural journalism characteristics and training of the agricultural journalist, how agricultural journalism is similar to and different from other types of journalism. Newspapers and magazines as communication media: Characteristics, kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers. Form and content of newspapers and magazines: Style and language of newspapers and magazines, parts of newspapers and magazines. The agricultural story: Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story. Gathering agricultural information: Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources. Writing the story: Organizing the material, treatment of the story, writing the news lead and the body, readability measures. Illustrating agricultural stories: Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions. Editorial mechanics: Copy reading, headline and title writing, proofreading, lay outting.

Practical

Practice in interviewing. Covering agricultural events. Abstracting stories from research and scientific materials and from wire services. Writing different types of agricultural stories. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading, headline and title writing, proofreading, layouting. Testing copy with a readability formula. Visit to a publishing office.